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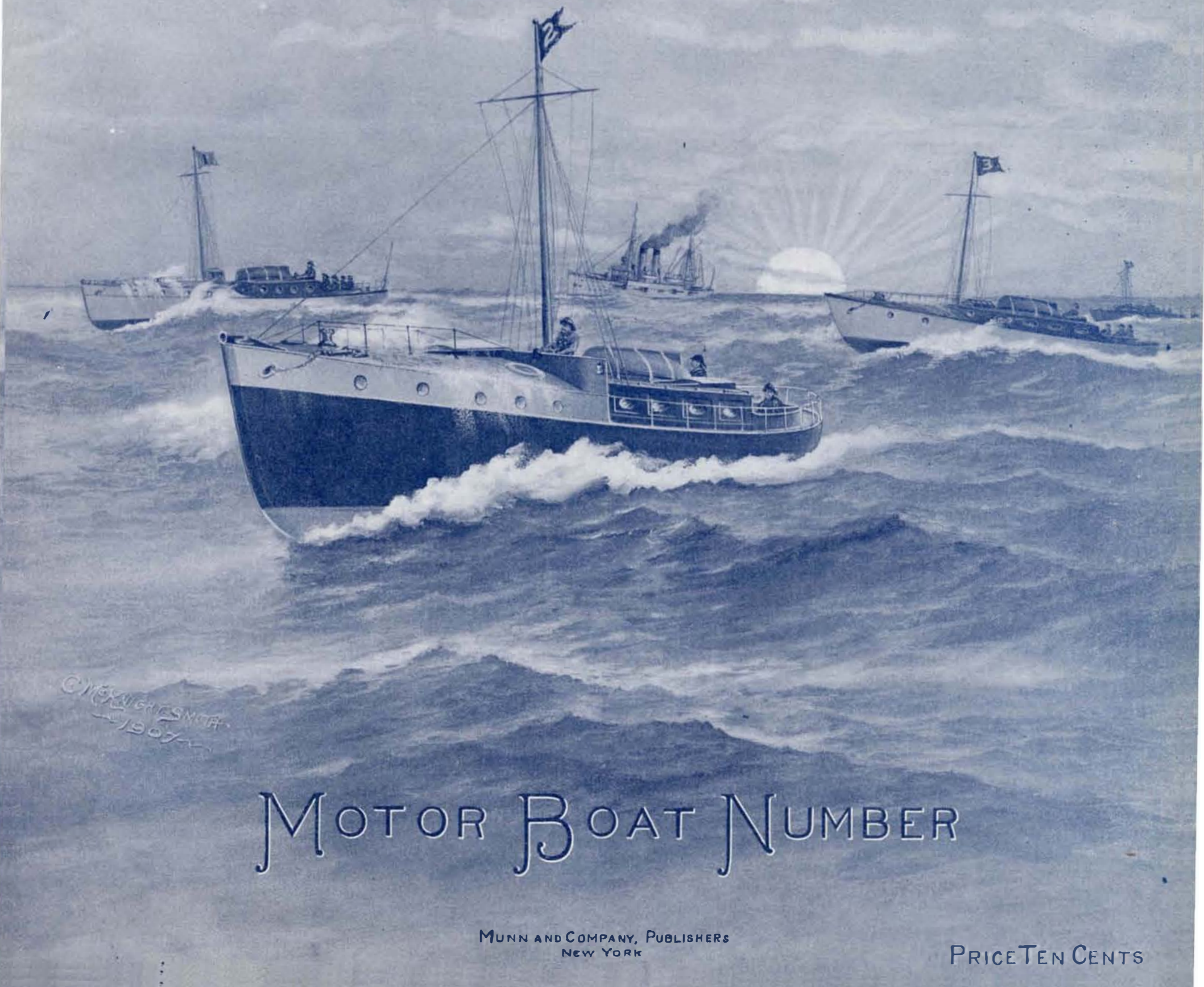

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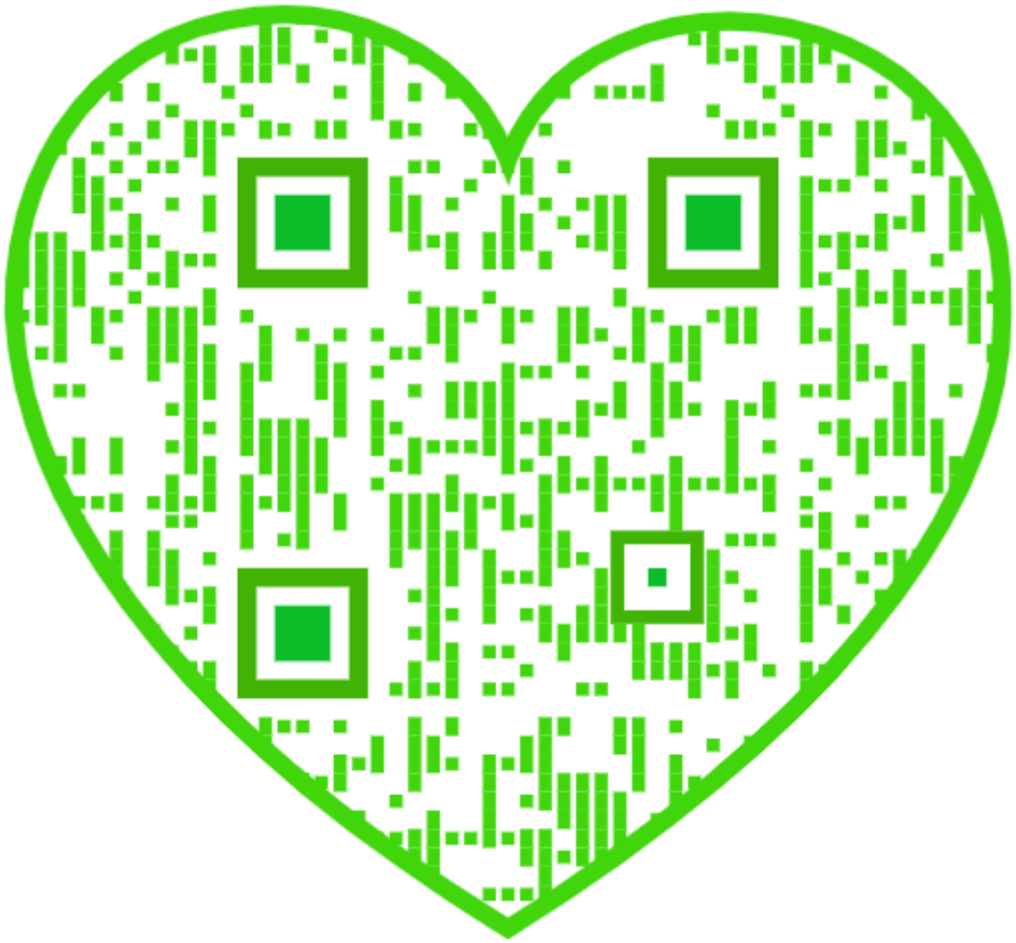

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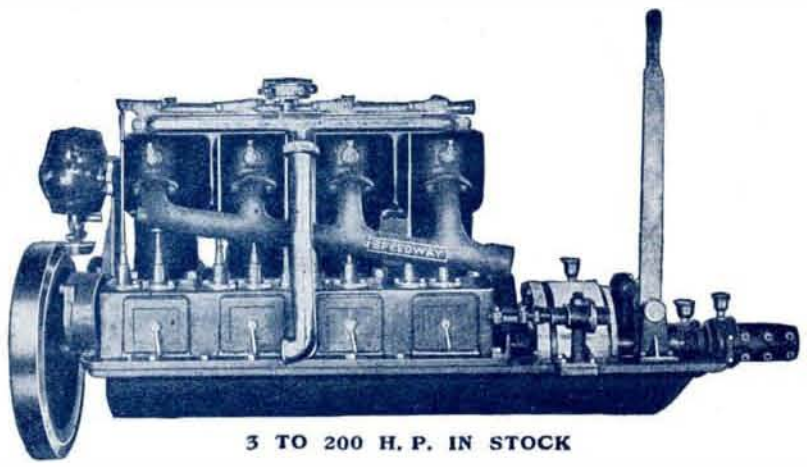

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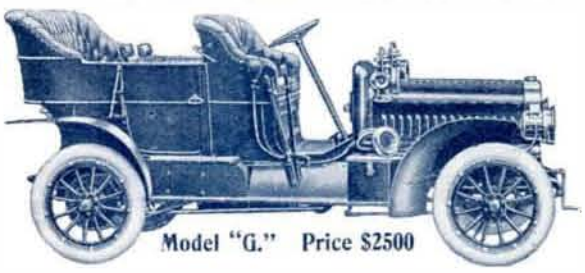

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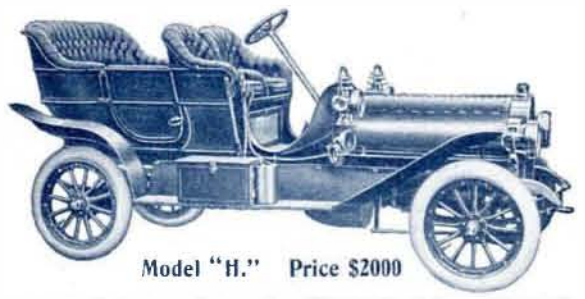

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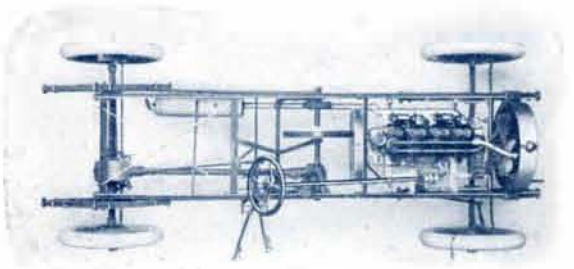

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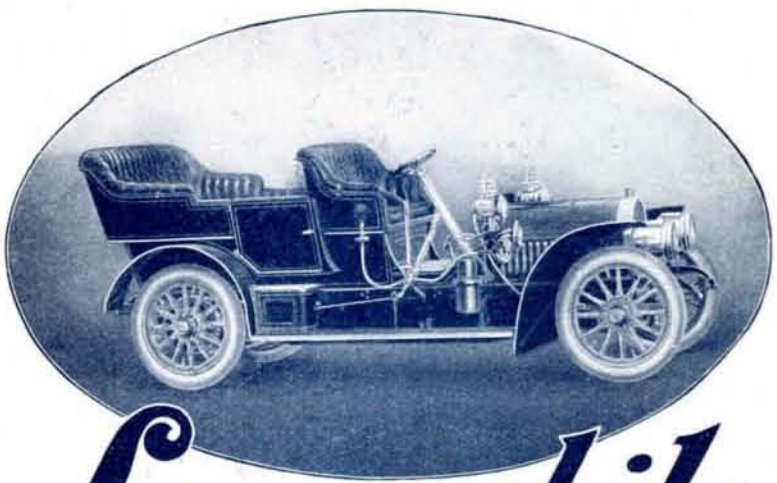

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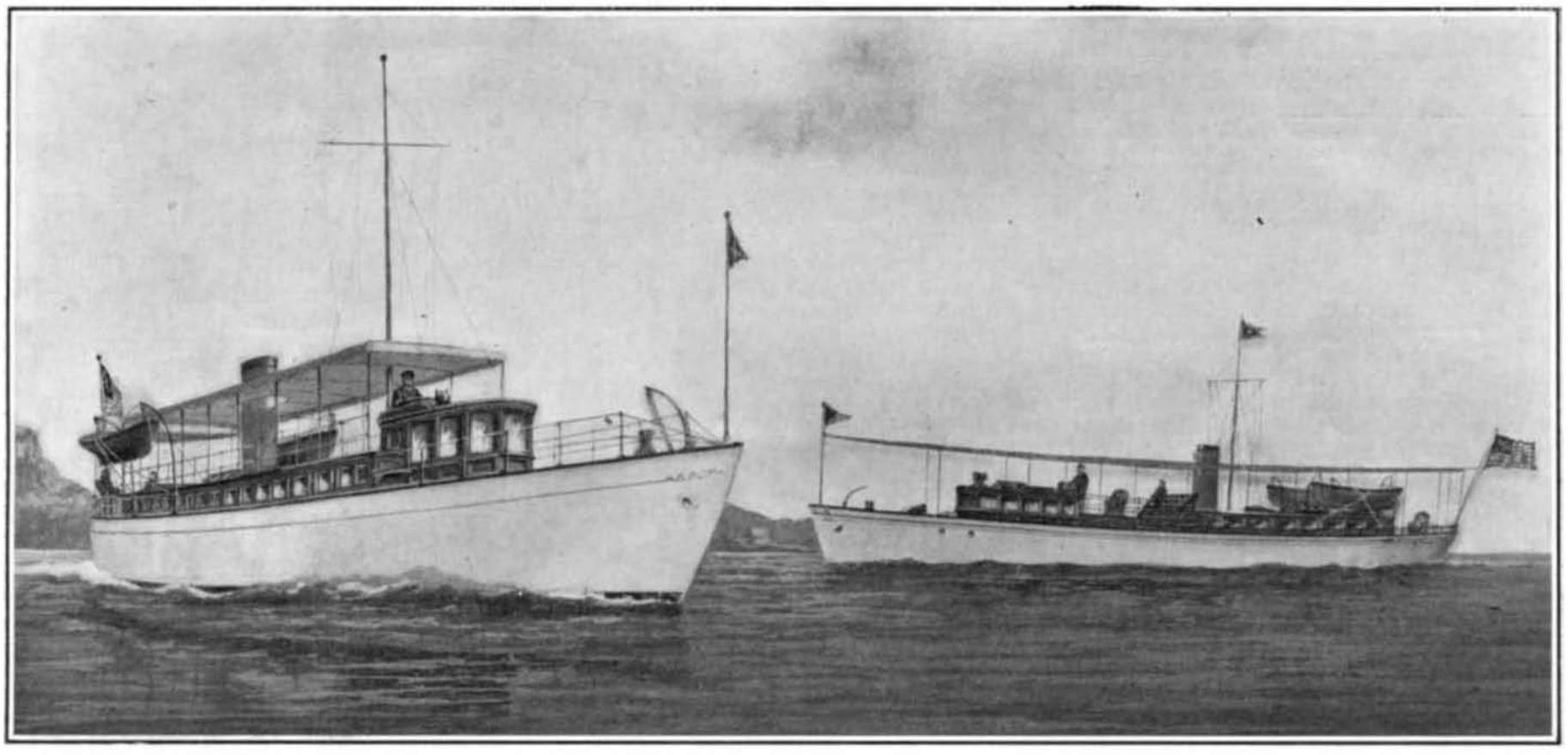

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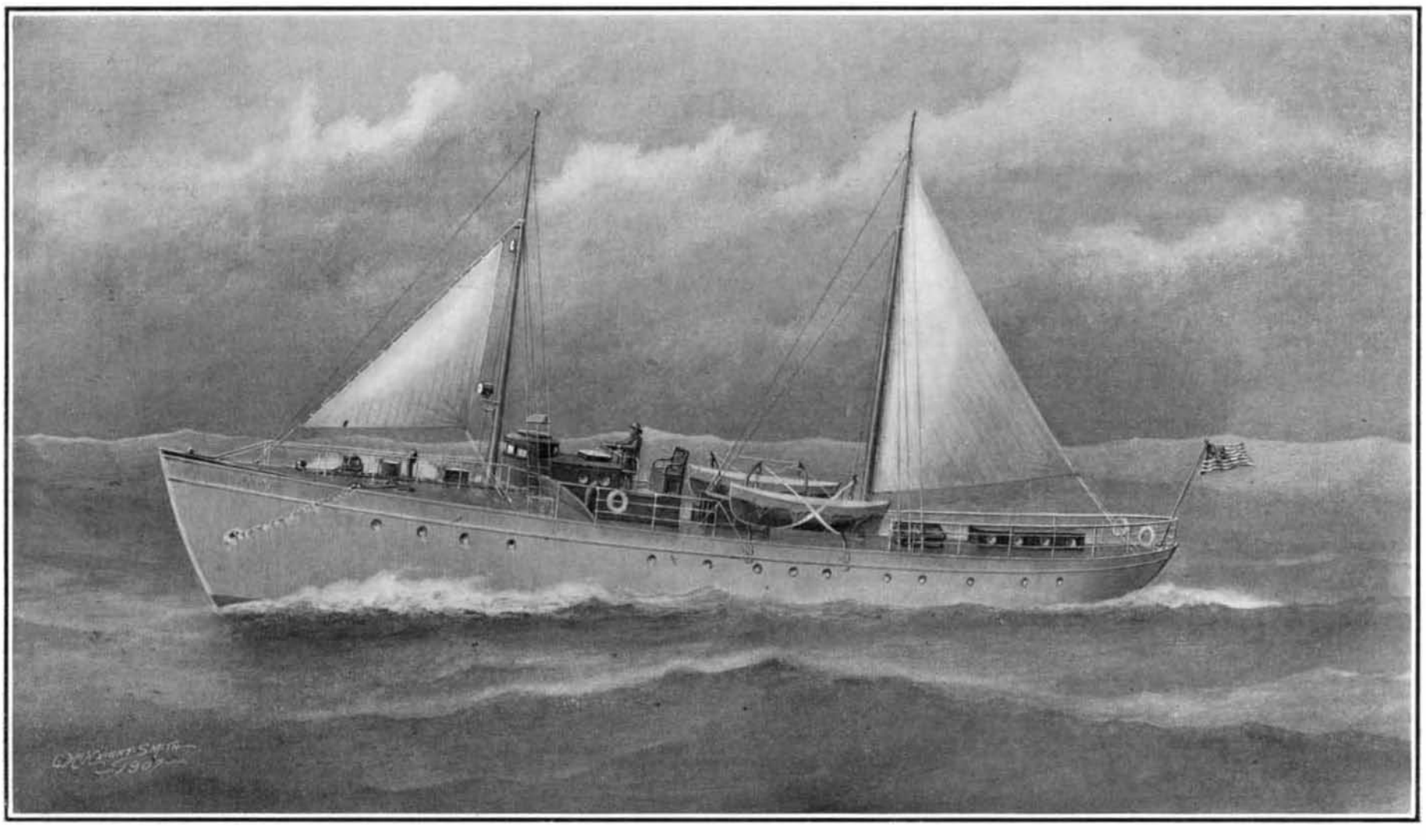

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LATEST TYPES OF CRUISING POWER BOATS.—[See page 167.]

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NEW YORK, SATURDAY, FEBRUARY 23, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE "LARCHMONT" DISASTER.

The awful disaster which occurred on the evening of Lincoln's birthday off Block Island, and resulted in the sinking of the steamer "Larchmont" with a loss estimated at not less than 150 souls, is not only one of the most tragic events in the history of navigation of Long Island Sound, but there are disquieting elements connected with the event, which may well shake the faith of the public in the safety of the older boats, and in the skill and heroism of the navigation and seamanship in these famous and much-traveled waters. The conditions under which the collision occurred, so far as they can be gathered from published reports, are altogether bewildering. Here, in comparatively sheltered waters, on a clear and starlit night, in spite of the fact that the captains of the two vessels, one a three-masted schooner, the other a side-wheel steamer, distinctly saw each other's lights when they were fully half a mile away—in spite of all this and the further fact that they had deep water and ample sea room, we find these two vessels so handled as to crash one into the other at full speed, and with all the appearance of deliberation. It is useless to speculate on the facts as here presented, and for an explanation we must be content to await the searching inquiry which must follow. It is certain, however, that the sailing vessel had the full right of way, and that it was the duty of the steamer to avoid her. The fact that the schooner rammed the steamer bow on would seem to indicate that the captain of the latter had made the too-frequent mistake of supposing that the superior speed of his ship would enable him to cross the bows of the sailing vessel.

Another feature which is disquieting, and certainly does not ring true with the best traditions of the sea, is the fact that so large a number of the officers and crew were saved, or at least got away in boats, while so many of the passengers, among them several women, went down on the vessel. In the presence of such a fact one's mind harks back to that fine old legend of the sea to the effect that the captain is always the last to leave his ship. On this point also will the public look for further and very definite information; and we can only hope that facts may be developed at the investigation which will give this phase of the question a more wholesome complexion than it wears at present. That the "Larchmont" should have foundered so rapidly after receiving the blow of the schooner proves once more how utterly unfit are some of these older steamers on the Sound and in the sheltered waters of our harbors and rivers for the safe carrying of passengers. It is certain either that there was no safety bulkhead construction in the hull of the "Larchmont," or that, if it existed, it was of a flimsy and practically worthless character. According to one account, the ship had transverse bulkheads built up of six-inch timber, but this, unless it was very heavily braced, would be altogether inadequate to withstand the water pressure, especially when the water in the hold was surging, as it would be, against the bulkheads with a momentum due to the rolling and pitching of the vessel. As a matter of fact, this question of non- or inefficiently-bulkheaded passenger vessels, whether for harbor or Sound travel, is one of wide significance, and fraught with untold danger to the passenger. If the traveling public knew how many of these vessels would prove, in case of collision, to be mere death traps, the shrinkage of travel upon them would be such as to compel the substitution of more modern and safer ships. If it shall result in stringent legislation to debar all but thoroughly well-bulkheaded vessels from the passenger-carrying trade, the loss of life on the "Larchmont" will not have been altogether in vain.

TREND OF MOTOR-BOAT DEVELOPMENT.

One of the most prominent facts connected with the present development of the motor boat is the waning interest in craft of the lightly-constructed and over-powered racing type, and the growing popularity of the more stanchly-built, roomy, seagoing boat of moderate power, with ability to make an extended cruise without replenishing the fuel supply. The decline in popularity of the type which is built exclusively for racing has been gradual, but decided, and particularly so during the past two years. It is unquestionable that there is a fascination about mere speed, which appeals strongly to the public mind; and in the earlier development of any of the high-speed devices which have figured prominently in the great field of sport and pastime, the accomplishment of high speed has appealed to the imagination and stimulated the efforts of designers and builders, largely to the exclusion of other and more valuable considerations. In the later years of the past, and the opening of the present, century this has been particularly true, as witness the construction and development of the yacht, the bicycle, and the automobile. But because of the great cost and limited usefulness of all mechanical creations which sacrifice every other consideration to that of high speed, the cost is so exceedingly high as to place them within reach only of men of considerable wealth and leisure. History shows us that when the possibilities of speed have been pretty well exhausted there is an inevitable reaction in favor of more moderate speeds and more durable and reasonable construction. The "speed mania," however, has always left behind it a valuable legacy in the way of useful knowledge as to the strength of materials, and as to just how far bulk and weight may be cut down without any sacrifice of absolutely essential strength.

The motor-boat industry may be said to have now passed from the first to the second and more important stage of its development, and although the high-speed races of the last year or two have shown that there still exists some enthusiasm in this form of sport, the number of extreme racing craft that is being built on the orders of private yachtsmen is relatively diminishing, while the orders for stancher vessels, of the fast and moderate-speed cruiser type, are increasing at a really remarkable rate. To-day not many of the extreme racing craft are built on private orders, the predisposing motive for such of these craft as are constructed being found in the desire of the makers and builders of engines and hulls to demonstrate the high quality of their product, by exhibiting it under the severe conditions necessary in the construction of a successful racing machine.

The popular type of motor-boat to-day is a moderate-powered cruiser, provided with a roomy cockpit and a substantial cabin with ample headroom, one or more staterooms, abundant lockers, a toilet, galley, and pantry, and all the accessories necessary for comfort on a cruise of several days' duration. Of course, the meeting of these requirements has necessitated an increase in size, and particularly in boats intended for deep-sea cruising, or for an extended trip in the more sheltered waters of Long Island Sound, or the extensive harbors of the South. Hence, the dimensions of a modern cruiser will be represented by a vessel from 30 to 60 feet in length, and furnished with engines of from 20 to 100 horse-power.

Perhaps the most potent influence in the development of this type of craft has been the institution of the long-distance races, which have grown in frequency and popularity during the past few years. Confined at first to courses laid through the Sound from New York to some point on the Massachusetts coast, these races have developed fast cruising boats, of such power and excellent sea-going qualities, that in the present year two important races are being run over ocean courses; one from Miami, Fla., to Nassau, a distance of 190 miles, and the other from New York to Bermuda. The latter is, of course, the more formidable undertaking, and the restrictions which have been laid down regarding the size and construction of the contesting boats have been so well drawn that there is no reason why all the contestants should not make the 700-mile trip in safety.

Although the flimsy racing craft has waned in popularity relatively to the moderate-powered cruiser, there will always be a demand for high-speed yachts, capable of averaging about 18 knots an hour, for what is coming to be known as "ferry" service, or the work of carrying business men to and fro between New York or other maritime cities and their distant summer residences. These craft run in length from 75 to 100 feet or over, and carry engines capable of giving them a sustained speed in sheltered waters of from 16 to 20 knots an hour. They are provided with ample deck space and spacious cabin accommodation, while frequently they will have a dining room and galley sufficient to enable the owner and guests to dine aboard if they should so wish.

The question has been asked as to whether the gasoline engine will be applied to ocean-going yachts of a size capable of making the transatlantic passage. One of our leading naval architects has recently expressed the opinion that in the present condition of the art this is not practicable, because of the prohibitive cost of the fuel. Moreover, it is undeniable that many prospective yacht owners would be deterred by considerations of the supposed risk attaching to the storage of large supplies of gasoline; although, as a matter of fact, by the use of proper precaution, the danger may be so greatly reduced as to be practically negligible. It is likely that under the stimulus afforded by the introduction of free alcohol, the designers of internal-combustion engines will succeed in designing motors so well suited to the use of this fuel, that it will ultimately prove to be more economical than gasoline; and there is not the slightest doubt but that with the more extended use of alcohol the price must ultimately come down to a point which will render it as economical as gasoline. When that point is reached, the added advantages of safety and absence of odor, etc., will render it such an ideal fuel that we may look for its extended use in the larger sizes of yachts, even in those capable of making the transatlantic passage.

Furthermore, the internal-combustion engine has several collateral advantages which must commend it strongly to the prospective yacht owner. By saving the expensive installation of boilers for a steam plant, the first cost of a gasoline or alcohol plant will be considerably less; and there will be a decided saving in the important matter of space. Also, for the same bunker or tank capacity, the steaming radius, or sailing radius, will be much larger than where steam power is used; while the comfort of the owner will be further assured by the absence of smoke and ashes, and the inevitable dust and disfigurement attendant upon coaling. Already, the way for the appearance of the large ocean-going gas-driven yacht has been prepared by the successful operation of the large auxiliary schooners, in some of which gasoline engines of considerable power have been installed and successfully operated.

GYROSCOPIC ACTION OF MARINE TURBINES.

We are most of us familiar with that ingenious device for preventing, or rather modifying, the rolling of ships, which consists of a heavy gyroscope, placed with its axis of rotation transverse to the longitudinal axis of the ship. The machine works on the principle that, to change the plane of rotation of a swiftly-rotating body by tilting the axis, requires an amount of effort which is determined by the weight and rotative speed of that body. The anti-rolling gyroscope, rotating in a plane at right angles to the direction in which movements of rolling of the ship take place, tends to resist those motions and modify their extent.

Simultaneously with the appearance of this device, and possibly suggested by it, there has arisen a discussion of the action upon turbine-driven vessels of the heavy and swiftly-rotating rotors of the steam turbine; for these, in addition to their proper work of driving the ship, undoubtedly act, because of their weight and high speed of rotation, with a powerful gyroscopic effect upon the pitching motion of the vessel. In this case, however, the gyroscopic action is felt in the direction of the longitudinal axis of the ship, and not, as in the case of the anti-rolling device, transversely thereto. Moreover, just as the anti-rolling gyroscope tends to modify rolling, so the gyroscopic effect of the heavy rotors of the steam turbines must tend to modify pitching, or vertical movement in a plane passing through the keel. Whatever modifying effect the device above referred to may have upon the rolling of a vessel, it is certain that the gyroscopic action of the turbine rotors can have none, or practically no effect upon the pitching. But since the gyroscopic resistance of the heavy rotors to a change of position of their plane of rotation is present and is considerable in quantity, it follows that they must exert a stress of no little amount upon the framing of the vessel itself. The proportion which these stresses will bear to the normal stresses for which the hull was designed will be largest in the case where turbines of great weight and high speed of rotation are carried in a long, shallow, and lightly-constructed hull, as in the case of a high-speed turbine torpedo-boat destroyer. These stresses would act very materially to increase the bending stresses which occur when a torpedo boat is being driven rapidly across the seas. In such a vessel they would become so large as to call for an increase in the scantling of the vessel, beyond that which would be necessary were reciprocating instead of turbine engines installed.

In the course of a valuable analysis of this action of a steam turbine, Mr. A. H. Gibson, of the Institute of Civil Engineers of Great Britain, some months ago called attention to the fact that the "Cobra," one of two high-powered turbine destroyers, built several years ago for the British government, and capable of steaming 36 knots an hour, broke her back and went down during a gale in the North Sea. This destroyer was built of the same scantlings as other destroyers in the British and Japanese navies, the difference be-

tween them and her being that they were driven by reciprocating engines and the "Cobra" by steam turbines of nearly double the power. Although no satisfactory reason was assigned for the disaster, Mr. Gibson believes that the additional stresses caused by the gyroscopic action of the rotors were mainly responsible for the disaster. Assuming that the two high-pressure turbines weighed 8 tons each and the two low-pressure 14 tons each, and that the speed of revolution was about 1,100 per minute, he finds that under certain conditions a couple might be called into play of 48 foot-tons, which would have to be resisted by the framing and shell of the vessel.

LONG-DISTANCE MOTOR-BOAT RACES FOR 1907.

There are at present but two important power-boat races scheduled for the coming season. Both of these are for cruising craft, and it is noteworthy that no contestant is eligible to entry in both races. These are known as the Marblehead and Bermuda contests.

The Marblehead race is the third annual race of a series which has been pulled off between New York and Marblehead, Mass., while that to Bermuda is an entirely new venture in the long-distance cruiser field. Both these races are laudatory, since such contests tend to develop a seaworthy, convenient, comfortable, and sensible type of cruising craft. If the results this year do not prove this to be true, indications are certainly misleading.

The first long-distance race for cruising power boats was conceived by Mr. Thomas Fleming Day, of "The Rudder," who offered a $250 trophy, to be known as "The Rudder Cup," to the Knickerbocker Yacht Club of College Point, with absolutely no restrictions as to conditions except that it was to be raced for by cruising power boats. This was late in 1904. The Knickerbocker Yacht Club accepted this cup, but, as there had been no previous contests of a similar nature, the club fully realized the amount of strenuous work such an enterprise would entail.

After several meetings the regatta committee presented to Mr. Day, for his approval, a draft of the conditions for the first race in 1905. These rules provided for a race for *bona fide* cruising power boats, not exceeding 40 feet length over all, and for the exclusion of any craft not having living and cruising accommodations for a crew of at least four persons. Paid navigators were also barred. American Power Boat Association rules were to govern. As a result there were sixteen entries, with twelve starters, as follows:

Boat.	Owner.	Engine.
"Blink"	C. W. Estabrook	Buffalo.
"Aquila"	A. H. Chase	Chase.
"May"	A. A. Low	Fulton.
"High Ball"	Richard Hutchison	Essex.
"Woodpile"	A. L. Lincoln	Barber.
"Glissando"	F. L. Andrews	Standard.
"Yeddo"	S. M. Smith	Twentieth Century.
"Em Bee"	Louis Neumann	Buffalo.
"General Bumps"	P. D. Irwin	Giant.
"Igniter"	C. A. Mezger	Buffalo.
"Aranca"	Arnold Schlaet	Standard.
"Talisman"	William Saville	Murray & Tregartha

Of these, all but six, viz., "Yeddo," "General Bumps," "Aranca," "Glissando," "Em Bee," and "Talisman," were new boats, built to conform to the conditions of the race.

The weather was the worst of the season, and after a hard trip across Nantucket Shoals, but five were able to finish and in the following order: "Talisman," "Blink," "Aquila," "Glissando," "Woodpile."

As "Talisman" was entitled to an allowance of nearly seventeen hours, there was no question of her winning the cup.

"Glissando" received second prize, and the other three handsome souvenirs.

In this race, as in that of the year following, the Eastern Yacht Club, of Marblehead, rendered valuable assistance, not only to the Regatta Committee of the Knickerbocker, but to the contestants themselves, the other two yacht clubs, the Boston and Corinthian, each vying with the Eastern as to which could do the most in that line.

Before the close of the year 1905, the Knickerbocker Yacht Club decided on a race for 1906. This was to be run in the opposite direction, i. e., from Marblehead to College Point. As a result, four prizes were offered, with fourteen entries and the following twelve starters:

Boat.	Owner.	Engine.
"Davy Jones"	Richard Hutchison	Jager.
"Unome"	Alfred L. Lincoln	Barber.
"May"	A. A. Low	N. Y. Kerosene Oil.
"Yo-Ho"	R. R. Curry & Sons	Ideal.
"Whew"	F. C. Webb	Murray & Tregartha
"Aranca"	Arnold Schlaet	Standard.
"Sis"	Eben Stevens	Craig.
"Susie"	J. B. Schmelzel	Fulton.
"Gertrude"	J. J. Tobin	Murray & Tragartha
"Shawna"	George C. Sutton	Lamb.
"Alice J"	Sidney Williams	Hasbrouck.
"Sarapa"	Swasey, Raymond & Page	Buffalo.

In 1905 "Talisman" took nearly 54 hours and 25 minutes to cover the course.

"Unome" finished first in 1906 in 33 hours, 45 minutes, and 40 seconds, with "Whew" second, "May" third, and "Sis" fourth. The last boat of nine to finish, "Susie," completed the 280 nautical miles in 39 hours, 5 minutes, and 29 seconds elapsed time.

Time allowance was figured on a modification of the 1905 American Power Boat Association rules, using 60 per cent of the table, with arrivals corrected so that the winners in their order were as follows: "Sis," "May," "Susie," and "Davy Jones."

The owner of "Sis," Mr. Eben Stevens, promptly offered a cup for a race in 1907. The Knickerbocker Yacht Club could not see its way clear to undertake the management of another race. Consequently, the New Rochelle Yacht Club will this year have supervision over the third Marblehead race.

Very slight modifications in the rules governing the 1906 contest have been made, the two principal ones being to limit the minimum length to 30 feet over all, instead of on the waterline, and the use of 50 per cent of the table of time allowance of the American Power Boat Association rules, rather than 60 per cent. The race this year will be from New Rochelle to Marblehead and will probably start on July 4.

The other race is from Gravesend Bay, off the Brooklyn Yacht Club, to Bermuda, a distance of about 700 statute miles. The minimum length of boats eligible for this race is placed at 39 feet, and the maximum at 60 feet.

This race is for a valuable trophy offered by Mr. James Gordon Bennett, the well-known yachtsman. It will be run under the joint auspices of the Brooklyn and Royal Bermuda Yacht Clubs. Careful conditions have been formulated, to avoid probability of disaster to any competing craft, each one being compelled to carry 6 square feet of sail for every foot of over-all length, and one and one-half times the quantity of fuel necessary to cover the distance under favorable weather conditions; while several other important salutary regulations are embodied in the requirements for eligibility for entrance. The conditions under which entries are to be made were published in the SCIENTIFIC AMERICAN of December 22, 1906.

This race is scheduled to start from the club house of the Motor Boat Club of America on June 1, and with good weather the run should not consume more than two and a half or three days.

It is reported that several boats are already under construction for each race, and it is likewise probable that boats already built, and eligible for the Marblehead race, will compete, while slight modifications, consisting in the main of the addition of auxiliary sail equipment, will allow several well-known boats to enter in the Bermuda trial, which will test the best points of such craft, such as their seaworthiness and endurance.

POWER BOAT NOTES.

You cannot "throttle" a four-stroke cycle engine to slow speed, unless the exhaust valve springs are sufficiently strong to prevent ingress of the spent gases through the exhaust valves, when there is a partial vacuum in the cylinder formed by the descent of the piston during its induction or drawing-in stroke. Weak exhaust-valve springs are sometimes encountered on marine gasoline engines.

There is an island near Marblehead, Mass., which is often mentioned in print. It is sometimes called Thatcher's and often Thatcher. It could not be Thatcher's, for in all geographical names now the apostrophe is omitted. What used to be called Riker's Island is now Rikers Island, while Fisher's Island has become Fishers Island. In the particular case mentioned, the latter is and has always been correct. It is Thatcher Island.

Conditions may necessitate installing propellers with excessive pitch, but such an installation should be avoided if possible. It must be remembered that the flywheel of the engine must be kept out of the water in the boat's "run," or space below the floor. This is sometimes accomplished by using a copper or galvanized pan under the lower part of the flywheel. Two-cycle engines give more trouble usually than four-cycle, when thus installed, and two-port engines more than three-port, if supplied with float-feed carbureters, the usual tendency being to get too rich a mixture in the after cylinder and too poor a mixture in the forward cylinder. Too much lubricating oil is quite likely to interfere with the ignition in the after cylinder if the engine is of the four-cycle type.

If you are in a power or sail-driven boat, and some other craft, steam or gasoline driven, willfully violates well-known "rules of the road," you should, at your earliest convenience, report the occurrence to the nearest United States inspector of steamboats, giving a full account of the occurrence, with names and addresses of eye-witnesses. A few cases of this sort would give many of our licensed masters and pilots what they richly deserve—suspension of their licenses—even although they are often goaded to desperation, as no doubt many of them claim, owing to the wanton disregard of the usual rules by many of our power-boatmen. Moral: Learn the "rules of the road" yourself, and do not take any chances, giving the other party plenty of leeway.

A sailing yacht shows the same lights as any sailing craft, the regulation red and green side lights, when under sail, and the white riding light when at anchor. A light is sometimes suspended from the end of the main, or spanker boom, to reduce liability of fouling, and while of great utility, and in a measure considered necessary, is not demanded by federal law or regulation. Small sailing craft are allowed to show a combination red and green light displayed in front of the mast, in place of the usual separate side lights. Small power craft, when using combination lights, should have a white light showing between the red and green. When showing separate side lights they should display a white masthead light. Towboats or any power craft when towing another craft alongside, should show two white masthead lights, one above the other, and when towing astern there should be three of these lights vertically arranged. The regulations governing lights on all craft are the same, no matter whether used for pleasure or business purposes, and are in force from sunset to sunrise.

Galvanized sheet-iron gasoline tanks are unsafe, and their use should be prohibited in all boats. Copper is very much better than any other material for fuel receptacles, although high-grade house boilers, galvanized after they are made up, on account of their cheapness, are permissible. The electric-welded, pressed-steel tank, however, is preferable to the riveted style. A precaution to be observed in the use of galvanized-iron or steel tanks is to see that salt water does not collect on them, or that they are not partially submerged in the boat. More important it is that no oak, or any wood carrying tannic acid, comes in contact with galvanized-iron tanks, else their life, owing to corrosive or galvanic action, is materially shortened. Galvanized-iron "swash" plates are preferable to those made of copper, owing to their greater rigidity, and such plates should be used in copper tanks. Soft, or hot-rolled, copper makes safer tanks than cold-rolled, and even this should be "tinned" on the inside, to insure the solder holding. All copper tanks should be protected against any possibility of fracture or puncture, by means of suitable bulkheads.

Rarely does a power-boat owner aspire to own the second craft with the propeller unprotected. Speed maniacs have set the custom. Floating debris, rocks, shallows, etc., make bad work with the unprotected propeller. It has been abundantly proven that high speed, with its allurements, is not all that is claimed or desired, that a comfortable, safe, good sea boat is a much more merchantable article and one less often offered for sale than so-called semi-speed or racing craft. It is possible so to design power boats that a good, satisfactory type with sufficient speed for comfort, may be produced rather than "freaks." Boats of abnormally high speed are decidedly dangerous playthings, not only for their own occupants, but those of other craft, who have equally as good rights to navigate crowded harbors and other constricted bodies of water. Power-boat racing, except for sensible cruising craft, died naturally something over a year ago. There is but one really good power-boat racer, and that is the very fastest one afloat. When such a craft is once beaten, her value is considerably decreased. In designing a boat to get the very highest speed possible, it is usually necessary to have the propeller project below the keel.

A jump-spark coil may be put out of commission easier by too high voltage than from any other cause. Adjusting the trembler, or vibrator, until there is very little play between the core and the small button or armature, is quite likely, especially with cheap coils, to fuse or burn up the metal contacts, between which a small spark shows when the primary, or low-tension, circuit is closed at the timer or distributor. Some coils are wound for but six volts, because they can be produced more cheaply than if wound to stand nine or twelve. Such coils should never be used with more than four dry cells, or six cells of so-called oil battery. A very frequent source of trouble with coils may be traced to their use in connection with sparking dynamos or generators. It is not safe to use them in the jump-spark system, without using an accumulator or storage battery, and a cut-out, either by means of a switch or an automatic device to prevent short circuiting the storage battery through the generator, when the engine stops. If the governor on the generator could be depended upon to maintain just the proper speed to produce the correct voltage, there would be no trouble, but around salt water particularly the governor is liable to "stick," with disastrous results. This is one of the bad features incidental to the use of jump-spark ignition. In the make and break system an increase of voltage to even twelve volts has no bad effect other than a tendency to burn out the igniter points, unless it runs so high as to break down the generator itself.

RECENT PERFORMANCES OF FRENCH HYDROPLANE BOATS.

BY OUR PARIS CORRESPONDENT.

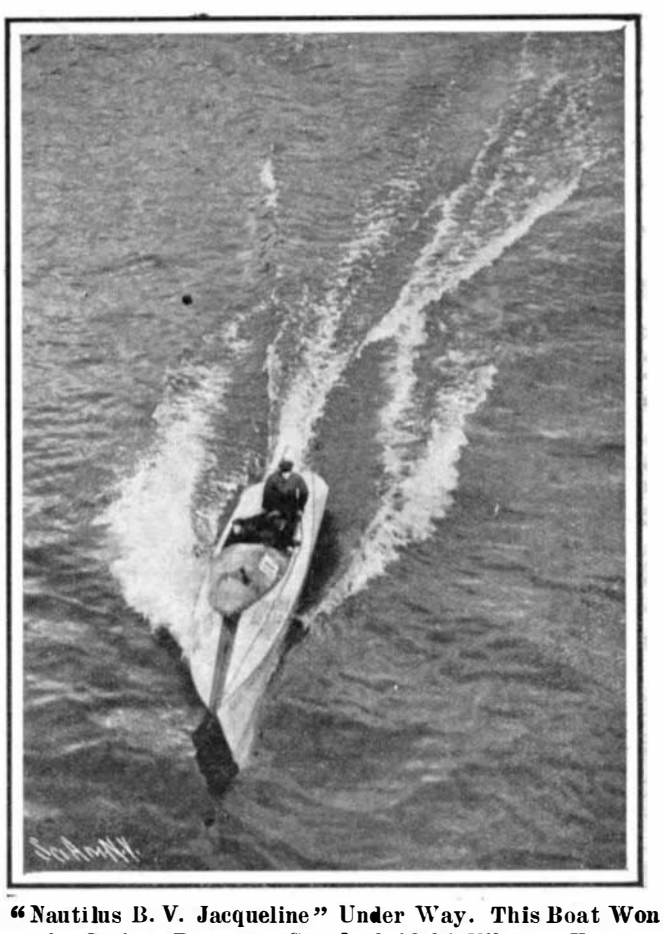
The gliding boat, or hydroplane, has been occupying considerable attention of late, mainly owing to the remarkable performance of the boat which the Count de Lambert constructed not long since and equipped with a light-weight, high-power motor. This craft succeeded in outdistancing all the racing boats of the usual build in a race held October 15 last upon the Seine near Paris, and it was this performance especially which directed the attention of the public toward the question of gliding boats, seeing that heretofore it was not generally known what could be expected from the new craft. Owing to the good results which have now been obtained by the hydroplane, there seems to be no doubt that it is quite in the line of progress, and we may expect to hear of still more remarkable performances from this class of craft in the future. The question is being actively taken up in the vicinity of Paris, and no less than three different forms of hydroplane boats have been run upon the Seine, with very encouraging results. As regards the principle which underlies all the recent forms of gliding boats, it consists in making the craft glide upon the surface of the water with scarcely any immersion of the hull. This is done by giving the boat a sufficient speed from the use of a light and powerful gasoline motor and at the same time placing a set of planes under the boat which are slightly inclined and turned upward from back to front, so that when the boat reaches a sufficient speed the action of the planes causes it to be lifted partly or almost entirely out of the water, the latter being the ideal condition. While the usual practice of the first experimenters was to use a boat of about the ordinary section and then adapt underneath it a set of separate planes whose angle was adjustable, in all the present boats the plane surfaces are formed simply by the bottom of the boat, this being constructed so that there are at least two surfaces of this kind. What is essential for the hydroplane action is to have the boat light enough to be easily lifted out of the water and at the same time to provide sufficient power to give the proper speed for bringing about the lifting action. This is now easy to accomplish in the present state of gasoline motor construction, especially since the new light-weight motors for aerostatic purposes have been brought out. In the early days of the hydroplane, inventors were handicapped, since they had only the steam engine available for the purpose, and thus a heavy weight had to be lifted, a weight which was out of all proportion to the power which the motor would give.

The Hydroplane Gliding Boat of Count de Lambert Getting Under Way and Rising to the Surface.

The boat consists of a catamaran mounted on five planes, each of which is about 4 feet wide by 10 feet long, giving a total lifting surface of about 200 square feet. The planes are set upon five per cent incline, with the exception of the front one, which is at a slightly greater angle. The 50 H. P., 8-cylinder motor has driven this boat, the inventor claims, at a rate of speed of thirty-four miles an hour.

As far back as 1876 M. de Sanderal had the idea of a hydroplane which consisted of a simple flat-bottomed boat of rectangular shape. At each of the four corners of the boat he mounted a propeller which worked horizontally in the water and was mounted on a vertical shaft. The boat also had a main propeller placed in the rear in the usual way. By giving the proper speed to the four screws at the corners, the boat could be lifted more or less out of the water so as to lessen the resistance to forward movement, and then the main propeller would cause the craft to glide on the surface of the water. He was not successful at that time in realizing this idea, since he found that the boat would require a considerable motive power, and hence that it could not be lifted by the use of a steam engine. Later on, M. Ader, of Paris, who is well known for his experimental work in different fields, took up the idea, and as late as 1895 he built a model of a gliding boat which somewhat approaches the present types. In this case he used a boat which was pointed at each end and was provided with a series of separate planes. At the front of the boat there were two planes spreading out at the sides and lying under water. They could be adjusted at any desired angle from the inside of the boat. At the rear there was a single plane which formed a tail and could also be adjusted. M. Ader had also the idea of injecting compressed air underneath the surface of the three planes, so that they would work more or less upon an air cushion and in this way the resistance of the boat would be still further diminished. It seems, however, that he did not succeed in making his craft work practically, as afterward he ceased to experiment with it and appeared to have abandoned the idea. This was no doubt due to the fact that at that date the gasoline motor was not sufficiently developed to be of service for gliding boats. Count de Lambert built his first gliding boat in 1897 and tried it in England, where he worked for some time upon the question. He used the idea of a catamaran formed of two long and pointed floats and between them he placed a set of flat pieces which constituted the planes and lay below the surface of the water. The planes were adjusted at the proper angle, which was found by experiment. On the craft he mounted a small steam engine of the Field type, together with its boiler, but as this gave him a heavy weight for a small power he could not bring the boat up to the speed which he is now able to secure with a light gasoline motor. Nevertheless, his results were encouraging, and he found that his idea was a good one. Since the advent of the gasoline motor he has been at work upon the question and has already built a number of boats. The most recent type which he is now running upon the Seine still holds to about the same construction, using two main floats running along the whole length and joined at the top by a light platform. In the present form the planes extend clear across underneath the floats so as to cover the whole width of the craft. The planes are formed of flat surfaces and there are a number of them (five) in the length of the boat. However, the plane which forms the front end of the boat has the end somewhat curved upward, as will be noticed in the photographs. During his experiments Count de Lambert has found the best angle to give the planes and the proper length, width, and spacing that they should have. The right spacing of the planes is one of the most essential points for the proper working of the boat. These are 10 feet long by about 4 feet wide and spaced about a foot apart. Toward the front end of the craft is mounted a 50 horse-power gasoline motor which weighs only 2½ to 3 pounds per horse-power. We have already described this type of motor, which has been adopted by Santos Dumont, Capt. Ferber, and other aeronauts, and which will go far toward solving the problem of the gliding boat, since for the solution of this problem a motor of high power and

Rear View of Count de Lambert's Hydroplane Boat Traveling at a Speed of 25½ Miles an Hour.



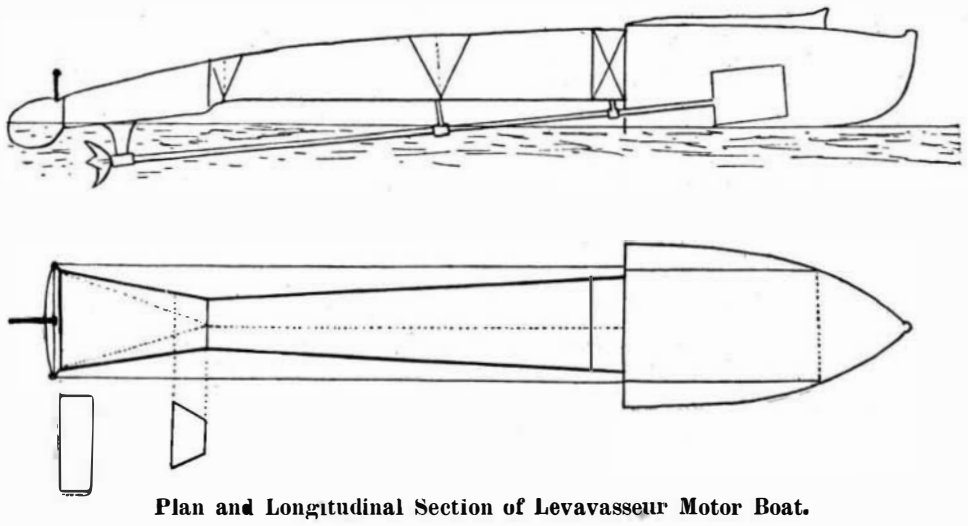
"Nautilus B. V. Jacqueline" Under Way. This Boat Won the Cruiser Race at a Speed of 16.84 Miles an Hour.

RECENT PERFORMANCES OF FRENCH HYDROPLANE BOATS.

light weight is essential. It is to be remarked, however, that this power is needed only in starting up the boat and bringing it up to the speed where the planes cause it to lift out of the water, for it is evident that as soon as it commences to glide upon the surface it requires much less power to run, owing to the great diminution of the resistance. This, at least, is the theory of the hydroplane, although in practice the large catamaran shown made only 25.46 miles an hour with the motor developing 50 horse-power at 1,000 R. P. M., while a smaller one of about one-half the size and one-fourth the hydroplane surface made the same speed with from 12 to 14 horse-power. The present motor is of the eight-cylinder V pattern and is rated at 50 horse-power, running at the standard speed of 1,000 revolutions per minute, at which it runs when driving the boat. The displacement of the present boat, without fuel or water, is stated by the inventor to be 1,100 kilogrammes (2,425 pounds), and with three men the displacement is brought up to 1,500 kilogrammes (3,306.9 pounds), although as many as five persons, inclusive of the mechanic, can be carried. The displacement of the smaller boat, loaded, was 1,763 pounds. From the motor the slightly-inclined propeller shaft passes to the rear. The blades of the propeller are each pivoted so that they can be turned and the pitch of the propeller altered. This is found very convenient for handling the boat. There is also a rudder which is mounted in the rear in the usual way. As to the size of the boat, the length is 7 meters (22.96 feet) and the width about 3 meters (9.84 feet). The whole is of a very light and solid build, and the top platform is made of the usual slat work.

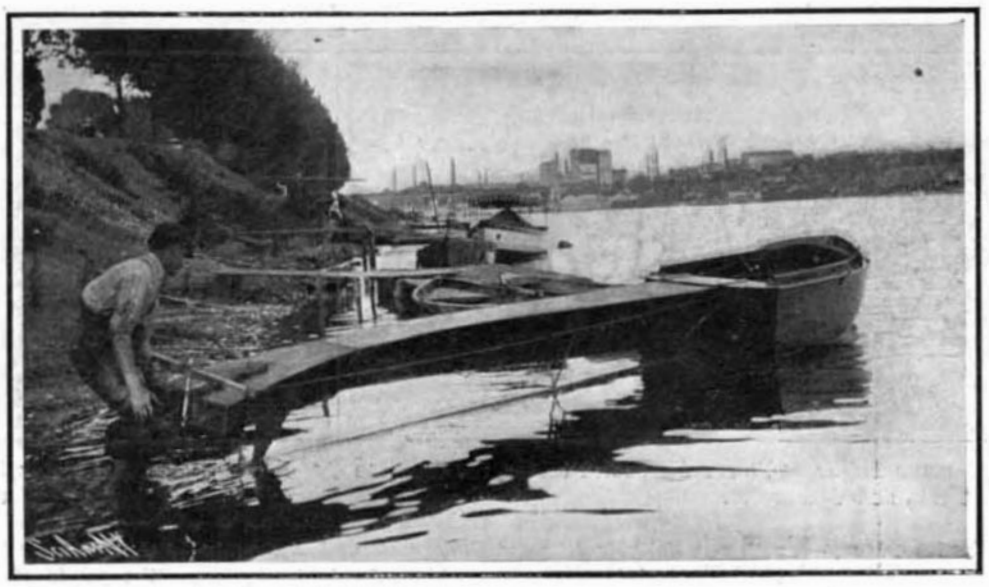
This craft made the remarkable performance which we mentioned above during the races which were held last fall upon the Seine at Maisons Laffitte, in the suburbs of Paris. In spite of the fact that there were entered some of the fast racing boats, the hydroplane carried off the honors and made the record for speed over a 100-kilometer (62.1-mile) course, covering this in 2 hours, 25 minutes, which is equivalent to a speed of 25.46 miles an hour. The boat carried three persons and besides was obliged to make a number of turns, which are a decided disadvantage for this class of craft. In a straight line, Count de Lambert says he made a speed of 55 kilometers (34.175 miles) an hour upon the Seine. At present he is constructing a new hydroplane, which is even of a simpler form. It is made up simply of a series of box floats placed between two long timbers on each side. Each float has the required plane surface on the bottom, and the assemblage of floats forms a kind of raft which has a number of gliding surfaces. It may be mentioned that Count de Lambert has been granted fundamental patents for the use of hydroplanes.

Another hydroplane boat which follows the same general principle, but which is much smaller in size, is the "Ricochet-Nautilus," constructed by the Bonnemaison boat-building firm of Paris. Its general appearance is shown in the illustration. The bottom is formed of two inclined plane surfaces one of which extends from the stern to the middle of the boat. Commencing a few inches lower down, at the middle, is the second plane, which also runs upward toward the front and forms the bow of the boat. A cross-section of the boat one-third of the way back from the bow shows that the forward plane is not quite flat, but has a slight curve. Upon the boat is mounted a three-cylinder, air-cooled, Buchet motor of 10 horse-power, from which a shaft runs to a propeller at the rear. The latter runs at the motor speed of 2,000 revolutions per minute when at full speed. The new craft has been tried upon the Seine, and is stated to run at 48 kilometers (29.825 miles) an hour. It is built to carry a single person. The oiling of the motor is carried out from an air-pressure oil tank, and the air pressure is given by a bicycle air pump. The rudder of the boat is shown at the front in the photograph, although two rudders at the stern are generally used.



Plan and Longitudinal Section of Levavasseur Motor Boat.

The Levavasseur Freak Motor Boat, "Antoinette."

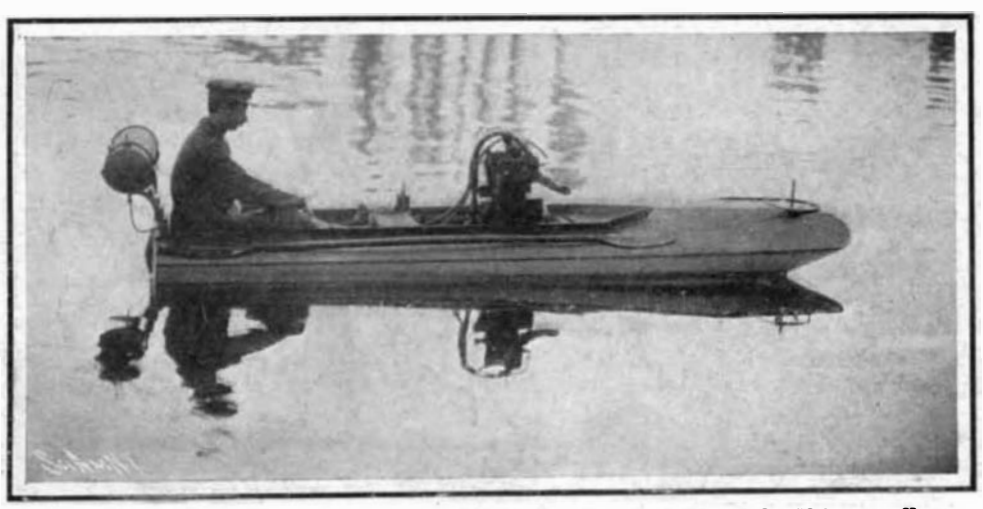


Tail of the Curious Two-Part Levavasseur High-Speed Boat.

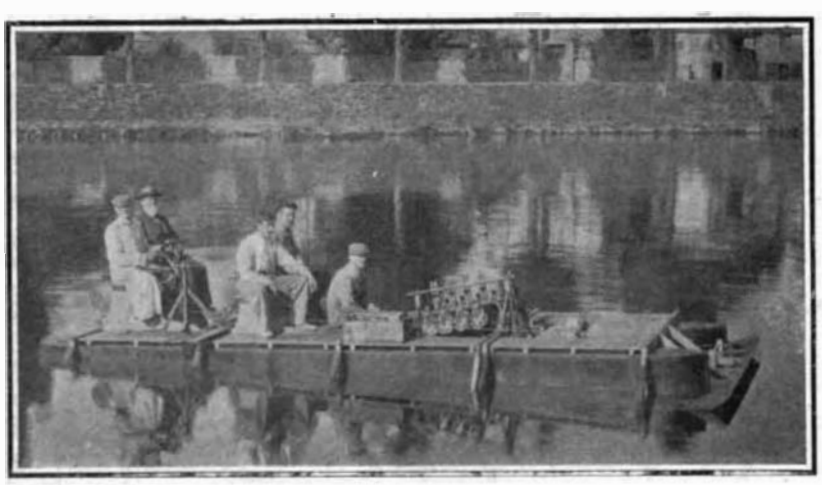
The "Antoinette" speed boat is built on somewhat different lines. In front it carries a flat-bottomed boat of somewhat the usual form, while in the rear is attached a float forming a tail-piece which aids in obtaining the gliding action. The front boat carries the motor and passengers. From the motor a shaft runs to a propeller carried in the rear of the tail-piece. The latter (see diagram) has at the end a box-shaped piece whose under surface forms a plane, and the whole device gives a constant angle for the front boat in order to secure the gliding action. By using the front boat, the craft can stand bad weather and run even upon rough water, although its speed will be slower in this case. It will run on the hydroplane principle in smooth water.

The craft is built for the Levavasseur motor firm, who have mounted on it one of the light motors previously described and rated at 50 horse-power. Alone, the motor weighs 132.27 pounds, or 176.36 pounds with all accessories and ready to run. The displacement of the craft is 200 kilogrammes (440.9 pounds) counting the motor, and the total length is less than 9 meters (29.52 feet). It has already been run upon the Seine and showed a good speed. Capt. Ferber and also Santos Dumont piloted it on different occasions and were favorably impressed with its performance, stating that it had a good balance and gave almost the same sensation as an aeroplane in the air. Owing to the use of the long tail, there is but little spray at the back of the boat, seeing that this is forced to the rear. Since it has entered the field the new craft promises well and gives the gliding effect without losing its qualities of good floating and balance. Another point is the low consumption of fuel, which is claimed to be below what the ordinary craft use, while a higher speed is obtained.

In the cruiser class, the record for 15½ miles was made by the "Nautilus B. V.-Jacqueline," which covered the distance in 52 minutes 36 3-5 seconds, at an average speed of about 16.84 miles an hour. This boat is noteworthy from the fact that it was driven by one of the new Bourdreaux-Verdet Duplex motors, which works on a new principle, and which we had occasion to describe in SUPPLEMENT No. 1597. The Duplex motor seems to be coming to the front on account of the different merits which it possesses in the way of low gasoline consumption per horse-power and the small space it occupies. One of the photographs on the preceding page shows the new cruiser at full speed. The clean way in which it cuts the water shows the design of hull to be a good one.



The "Ricochet-Nautilus," Which Has Attained a Speed of About 30 Miles an Hour With a 10-Horse-Power Motor. This Boat is About 11 Feet Long.



Count de Lambert's Hydroplane Boat at Rest, Showing the Normal Submergence When Stationary.

RECENT PERFORMANCES OF FRENCH HYDROPLANE BOATS.

THE BRANGER CUP RACE FOR MINIATURE MOTOR BOATS.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Considerable interest was recently manifested in Paris in a series of races for model motor boats. A cup for one of these events was presented by M. Branger, a well-known French photographer of sporting subjects. The races were held on the lake of the Bois de Boulogne over a course some 150 meters (492.125 feet) in length, and they were watched with interest not only by the children but by their elders as well.

Some of the little craft traversed the distance at surprising speed, and a number of curious forms of miniature launches were to be seen, as the accompanying illustrations show. One of the conditions of the contests was that none of the competitors was to exceed 5 feet in length. Some of the latter were considerably smaller; in fact, one of the winners was but 23.6 inches long. There were twenty-four starters in the races, which were watched with great interest by a large crowd of spectators.

There were races for different classes and a special class contested for the cup. Some of the boats were driven by electricity, while others were provided with explosive motors; one of the latter was of 1¼ horse-power and was, as can be seen in the illustration, a single-cylinder, air-cooled motor fitted with high-tension magneto ignition, flywheel, friction clutch, etc.

Despite a damp and rainy day, these toy racers made a very fair performance, as can be seen by the following table of winners:

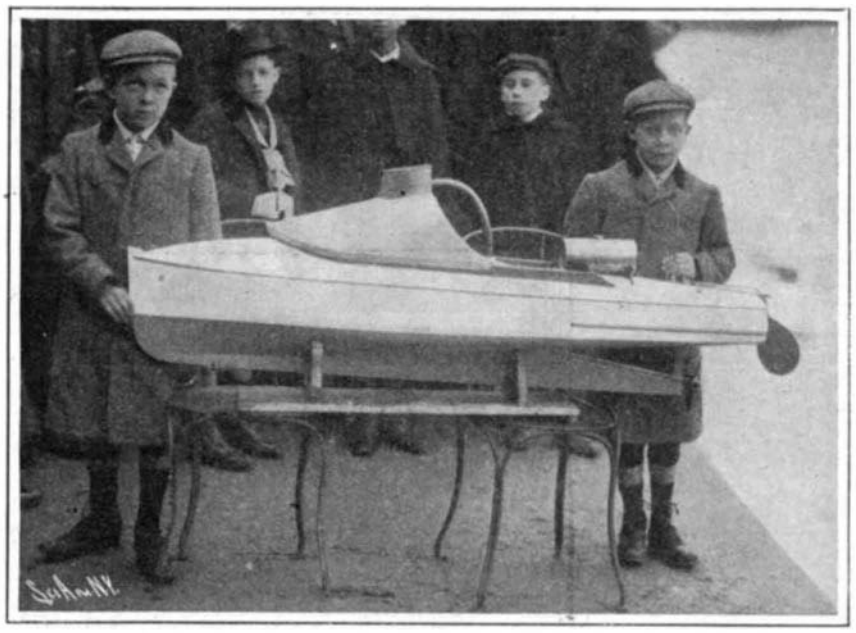
Racers 0.60 Meter (23.62 inches) in Length: Winner, "Girard IV." (owned by Girard), 2 minutes 27 seconds.

Racers 1 Meter (39.37 inches) in Length: Winner, "L'Eclair" (owned by Leroy and Breton), in 2 minutes 47 seconds; 2, "Girard III.," in 4 minutes 30 seconds.

The winner of this event was given the superb silver medal donated by "Les Sports."

Racers 1½ Meters (59.05 inches) in Length: 1, "Girard I.," in 1 minute 5 seconds (5.16 miles an hour); 2, "Lorraine" (owned by Pierre de Fontbrune), in 1 minute 50 seconds; 3, "Catarina" (owned by Letang), in 2 minutes 45 seconds.

The race for the "Coupe Branger" was won by the "Girard I." in 1 minute 20 seconds. "L'Eclair" was second in 2 minutes 20 seconds; and "Lorraine" was third in 2 minutes 25 seconds. The consolation prize was won by "Catarina" in 1 minute 16 seconds. This first toy motor-boat meet was very amusing, and was attended and directed by several constructors of motor boats, who gained not a little information as to the speed capabilities of different forms of hulls.



The "Girard I.," Winner of the "Coupe Branger."

The Death of Henry C. Sergeant.

In the death of Henry C. Sergeant, which occurred January 30 at his home in Westfield, N. J., America has lost one of her most brilliant inventors. To the inventive genius of Mr. Sergeant the elevated railroad companies owe the chopping boxes, which enabled them to stop the use of uncanceled tickets on their lines, and materially to increase their profits. His first invention, which he worked out when only eighteen years old, was a machine for making wagon wheels. In 1862 he patented a governor for marine engines to prevent the racing of propellers. This governor the United States government at once adopted for war vessels. He took out patents on more than fifty air compressors and drills, and his development of the drill that bears his name made it possible to carry out some of the greatest engineering achievements of the last quarter century.

The Effects of Ether and Chloroform on Plants.

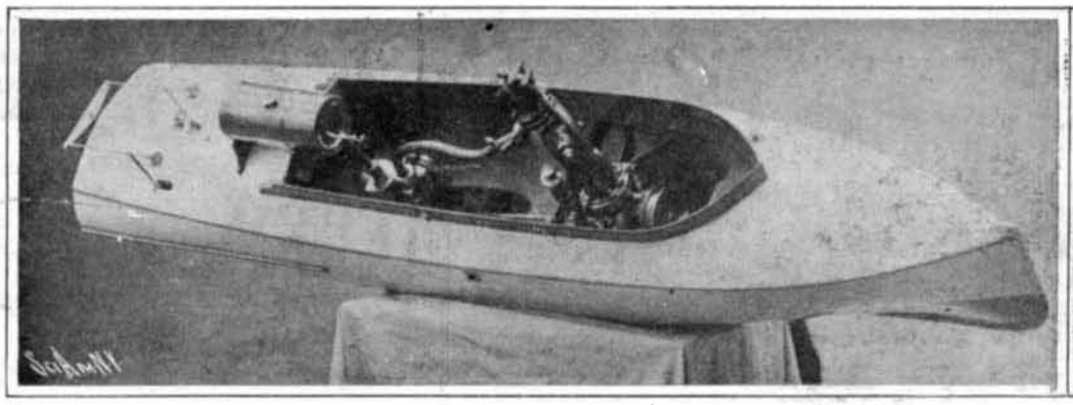
The forcing of plants by means of ether has attained great practical importance. The process, however, is not applicable to all plants, for the growth of many species is retarded by ether, which appears to exert on them an inhibiting action as it does on the nervous system of animals. Alfred Burgerstein has recently published the results of experiments on the effects of ether and chloroform on a great variety of plants. He studied especially the action of ether on the buds of deciduous trees and shrubs and the effects of both ether and chloroform on the growth of bulbs and the germination of seeds. The unfolding of some buds was accelerated, that of others unaffected by etherization. Begonia buds were retarded. Etherized narcissus bulbs sprouted a week earlier and etherized onions three days later than untreated bulbs, while tulips were not affected by ether.

Etherization continued for 48 hours, using 3 volumes of ether to 10,000 volumes of air, exerted no further injurious effect on bulbs, but the same proportion of chloroform killed them all in 8 hours. The germination of air-dried seeds was accelerated by exposing them for 24 hours to an atmosphere containing from 2 to 8 volumes of ether to 10,000 volumes of air, but the proportion of seeds that germinated was not altered. Chloroform, employed in the same manner, accelerated the germination of some seeds and retarded that of others, but it generally reduced the proportion of seedlings. When the seeds were first soaked in water etherization diminished their germinating power and chloroform, in most cases, killed them.

The growth of bean, pumpkin, and sunflower plants was almost or entirely checked in an atmosphere containing 0.004 per cent of chloroform, but the same proportion of ether promoted their growth and the plants throve in air thrice as strong in ether. The effects on the power of reaction to light and gravitation were analogous to the effects on growth.

It appears, therefore, that the entire vital energy of some plants is increased and that of others diminished by ether and chloroform.

The special commission appointed to consider the construction of bridges will recommend to the New York Legislature the construction of two bridges from Staten Island and one from Manhattan to New Jersey.



Plan View of the "Girard I.," Showing the 1¼-Horse-Power Air-Cooled Motor, the Gasoline Tank, and Carbureter.

A Group of Model Motor Boats, Showing the Different Types and Sizes.

A Well-Designed Entry.

Preparing Some of the Contestants for the Races.

THE RACES IN THE LAKE OF THE BOIS DE BOULOGNE, AT PARIS, FOR MINIATURE MOTOR BOATS.

LATEST TYPES OF CRUISING POWER BOATS.

In the first-page illustration of this number of the SCIENTIFIC AMERICAN are shown three of the latest types of cruising power boats. The two shown in the upper part of the illustration are "La Mascotte III." and the "Dixie," the first of which was designed by Mr. H. J. Gielow for Mr. F. C. Havens, of San Francisco, and the latter by the Electric Launch Company.

"La Mascotte III." is 84 feet over all, 75 feet 9 inches on the waterline, with a beam of 13 feet, and a draft of 3 feet 6 inches. On deck forward are a pilot house and a cabin, provided with the usual transoms, table, lockers, and buffet. The staterooms, which contain berths and lockers, are arranged on each side of a passageway leading to the engine room.

Each of the staterooms connects with a private toilet room. The quarters of the crew are aft, and provide accommodations for two men. In the engine room are two berths, seats, lockers, etc., for the members of the engine-room staff.

The vessel is driven by two 75-horse-power Craig gasoline engines, and it is provided with the necessary lighting, ventilating, and other auxiliaries. The fuel supply—620 gallons at a maximum—is carried in tanks located in water-tight compartments. The vessel is steered from a bridge aft of the pilot house, and is equipped with a single military mast and a stack.

The "Dixie" is 93 feet over all, 85 feet 9 inches on the waterline, with a breadth of 13 feet 6 inches, and a draft of 4 feet. Her accommodations consist of a forecastle, finished in quartered oak with brass air ports for light and ventilation. The owner's quarters, which are also forward, and are finished in African mahogany, contain two Pullman berths equipped with regular Pullman car fittings with drawers for storage. There is also a bureau with plate-glass mirrors and extra wide and deep drawers. The owner's private bath is adjoining and contains a porcelain tub, shower bath, basin, and a large closet. The windows in the owner's quarters are of plate glass, protected by Venetian blinds, while additional ventilation is secured through a large skylight.

The galley is situated aft of the engine room and extends the full width of the boat. A large range burning either coal or wood is provided, together with a roomy ice box, having a capacity of 650 pounds of ice, a sink, cupboard, dresser, and closets.

The main saloon is 19 feet long, finished in mahogany, and contains a large Chippendale sideboard with glass doors, drawers for silver, linen, etc. There are also four standard Pullman berths, and a toilet room opening into the saloon on the port side forward. The windows in the saloon are protected by Venetian blinds, as in the owner's quarters, while a large skylight furnishes additional light and ventilation.

The engine room contains two 110-horse-power 6-cylinder Standard reversible engines and an 8-horse-power gasoline engine direct connected to a dynamo for supplying electricity throughout for lighting, searchlight, fan motors, heating and cooking.

The yacht will be steered from the bridge and will also be equipped with military mast, stack, one 14-foot dinghy, and a 15-foot 6-inch power tender, with a 2-horse-power engine; an awning covers the entire yacht.

The hull has been very substantially built, having an oak keel and frame and yellow pine planking, all copper or yellow metal fastened.

The craft illustrated in the lower engraving is the "Hawk," which was designed and built by Mr. C. Du Poix, of New York city, for a gentleman residing on the Isle of Pines. It was intended for use both as a pleasure yacht and as a passenger carrier during the busy season of commerce. The conditions of service necessitated a seagoing power yacht of fair speed and wide cruising radius for operation in and around the Caribbean Sea. Weather conditions in that part of the world often put the craft plying those waters to the severest possible tests, and the question of seaworthiness was a factor of the greatest importance in the design of the "Hawk."

The vessel is built entirely of steel, with six watertight compartments, and the construction is one which offers great strength of hull. The deck is flush, with but a single companion way, that leading to the owner's quarters. All other openings are either watertight torpedo hatches or watertight steel skylights. There are two engines, each of 75 brake horse-power, using gasoline fuel. The latter is carried normally in four tanks placed abreast, each in a watertight compartment and provided with a water seal. Extending forward from the engine room bulkhead for 14 feet is a double bottom, the space within which is adapted to be used as a reserve fuel tank, or otherwise as a ballast tank. The full tank capacity totals 2,000 gallons.

Most of the auxiliary power devices are electrically driven. They include the lighting plant, the fire and bilge pumps, an ice-making plant of the Brunswick Refrigerator type, and the ventilating system. The ice machine compressor is driven by a 1½-horse-power motor in the engine room. The cold storage and ice compartments are located in the galley. Twenty pounds of ice are manufactured per day, while at the same time two refrigerating compartments are cooled. The cooking is done upon an electric range, an auxiliary oil stove being provided for emergencies.

A system of forced draft provides ventilation. An electric blower is placed aft of the conning tower, where it is shielded from breaking seas. This forces air through lines of pipes, one on each side of the boat, just above the cabin floor. Each room contains proper regulating apparatus for use in connection with the ventilation system. The air is withdrawn from the various parts of the craft through flat pipes located near the gusset plates on each side of the hull. These pipes unite in the engine room and communicate with an exhaust blower, which expels the air through a ventilator.

The conning tower is located well forward, and not only provides a place for the steersman in bad weather, but is also a chart room and smoking den. It is provided with a large, comfortable leather divan, adapted for sleeping purposes in case of necessity. Two sets of steering gear are provided in the conning tower, as well as an engine-room telegraph, a telephone to all parts of the vessel, and the usual bell signal system and speaking tubes. The electric masthead and side lights have telltale lights showing in the conning tower. The lights, as well as the searchlight and the siren, are controlled from within the latter. An auxiliary steering gear is provided on the platform aft of the conning tower for use in fair weather.

The accommodations and living arrangements are all of the very best. The toilet and bath rooms are of the latest design. The main saloon is large, airy, and comfortable, and is provided with two transom berths, a self-playing piano, buffet, bookcases, lockers, etc. Accommodations are provided in the forecastle for a crew of four, and two berths are located in the engine room for the crew of that department.

The joiner work throughout is of composition fireproof board painted with white enamel. Interlocking rubber tiling is used in the saloon, bathroom, passageways, and in the pantry and galley. The upholstery is of dark green leather. Two boats are carried in patent folding davits—a power dinghy and a whaleboat. The deck is of teak, with all deck fittings of steel.

Aeronautic School in Germany.

Arrangements have just been completed to establish at Chemnitz a training school for aeronauts and constructors of airships. A similar school has been in operation in Paris for a year past. The Chemnitz institution will be the second enterprise in this new pedagogical field. A one year's course is contemplated for the present, the school to be opened in May, 1907. This course, at the outset, is limited to the construction and use of balloons. It will be enlarged so as to include aeroplanes, as soon as practical working types have been developed.

The successive divisions of instruction during the year's course are as follows: Calculation of volume of balloons; methods of cutting the material; methods of rendering the material impermeable; construction of nets; gases used for inflation; the general theory of balloon construction and use; scientific instruments used in balloon ascensions; meteorological observations; ascents alone; ascents with passengers; special instruction for passengers; methods of landing, and the application of airships. The tuition for a year's course is 600 marks, or $143.

The Current Supplement.

The current SUPPLEMENT, No. 1625, opens with an article by Dr. Alfred Gradenwitz on the Southwestern African Railway, which is probably the longest road of its kind in the German colonies. Good pictures accompany his description. Mr. Walter J. May tells how unusual castings can be made. The mechanical design of ball bearings and roller bearings is ably discussed by W. S. Rogers. The first installment is given of a series of articles on plaster-of-Paris. Mr. W. E. Parsons contributes a well-considered forecast of our manufacturing industry. Mr. F. P. Fish's admirable elucidation of the ethics of trade secrets is concluded. The purchase by the British Admiralty of a gasoline, motor-driven torpedo boat is an official indorsement of a new type of fighting craft. For that reason the SUPPLEMENT'S illustrations of these new types, together with an article, will be of interest. The flights of Zeppelin's airship on October 9 and 10, 1906, are described in detail by Prof. Hergesell and Capt. von Kehler. Electric sleep or anesthesia is a subject of which we are bound to hear more in the future. Dr. G. H. Niewenglowski's brief review of his experiments and those of Prof. Leduc should, therefore, be read with interest. In an article entitled "Theory and Action of a 100-Mile Wireless Telegraphic Set," A. Frederick Collins tells something of the theoretical action and the practical working of the instruments employed in the 100-mile wireless telegraph equipment which is described in SUPPLEMENT, No. 1605.

INFLUENCE OF THE AUTOMOBILE ON LAUNCH DEVELOPMENT.

BY W. P. STEPHENS.

Following closely on the Automobile Show comes the Motor Boat Show at Madison Square Garden, marking a new era in launch and gasoline-engine building. As the Automobile Show had its germ in the great bicycle shows of the late nineties, so the gasoline launch has served as an incidental attraction to the annual Sportsmen's Show until the present time, when it takes its place as one of the great yearly show attractions of New York.

Though antedating the automobile by nearly a dozen years, the marine gasoline engine was at the time of the first Automobile Show in 1900 but little advanced beyond its early primitive stage. Its manufacture was regularly established, it had found a limited market among yachtsmen and to a certain extent among fishermen and other workers, and, mechanically, it had reached a point where it was sufficiently reliable and economical in operation to justify its use in spite of many serious defects; but it was found in only one very heavy type, built almost entirely of cast iron, which made it bulky. Its design was such that it was limited practically to the low speed of about 300 revolutions per minute. Besides this it was weak in its respiratory organs (the primitive vaporizer or carbureter of the day), and was fitted with an ignition system of the make-and-break type that had hardly passed the experimental stage. Its possibilities being unknown to the yachting world, the only demand was for this ordinary heavy type of engine for cruising launches or working boats, and there was no inducement to the builder to invest large sums in the development of lighter and more efficient engines. Even the most progressive builders of the day aspired no higher than the improvement in detail of the heavy launch engine.

In England and France the development was even more backward, launches being few in number and mainly propelled by kerosene, in every way inferior to gasoline as a fuel. The awakening came, however, in the latter country, where in 1900 the new type of light, high-speed, automobile engine was first tried in a launch hull. The experiment was successful. New hulls of special design and construction were soon afloat, driven by the leading makes of automobile engines; the vocabulary was enriched by a brand-new term—"canot-automobile"—and the new sport of high-speed motor-boat racing was fairly launched.

From the start the "auto-boat" or "canot-automobile" all but rivaled the motor car in popularity. Races were held for valuable prizes; the cleverest of naval architects were called on for designs of lighter and faster hulls, and all the resources of automobile engineering were called into play for the perfection of the new type of "auto-marine" gasoline engine. The fever was by no means confined to the Seine and the Mediterranean, but found its way across the Channel and even across the broad Atlantic, meeting a hearty welcome from American clubs and yachtsmen.

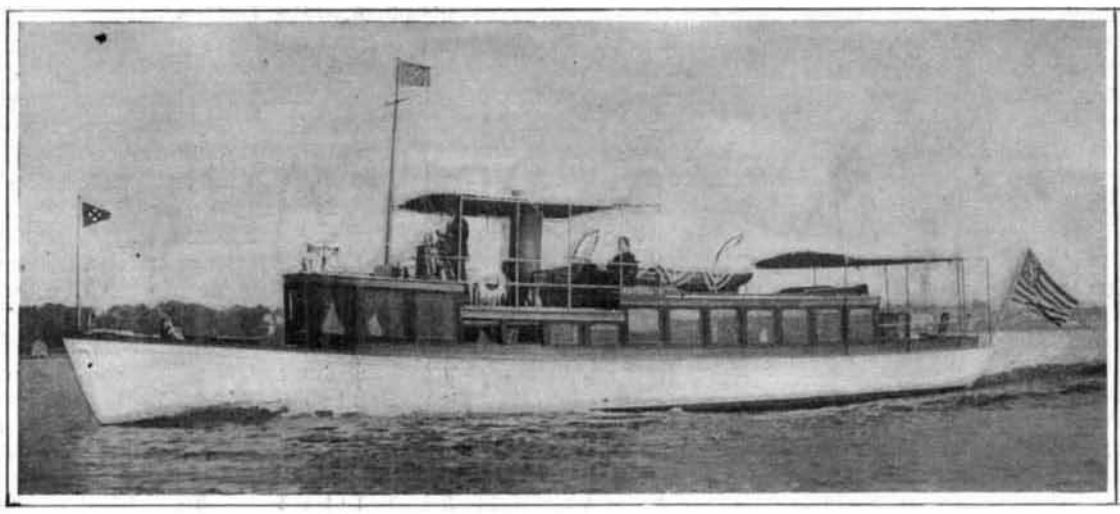
The high-speed auto-boat has proved to be little more than a costly and useless toy; the hull, designed solely for the highest possible speed, gives neither comfort nor accommodation, while the passenger, even in smooth water, is drenched with a cataract of spray thrown by the razor-like bows. The extremely light construction makes the boat useless except for racing; the light and delicate engines require the highest possible skill for their care and manipulation, and they are always liable to derangement and breakdowns. The first excitement over, the sport has proved far less fascinating than at first promised, owing to the great number of failures of entered boats to start, or, having started, to finish the course.

In spite of its own defects, however, the auto-boat has been a blessing to yachtsmen and to engine builders alike, in that it has forced in less than five years a development that, to all appearances, would in its natural course have taken twenty years. To put it briefly, where the average speed of the pleasure launch was well under ten miles per hour half a dozen years ago, the effort to attain a speed of thirty miles in the auto-boat has raised the average speed probably 50 per cent, while there are staunch, strong, and seaworthy launches that run regularly over twenty or twenty-two miles in the hour.

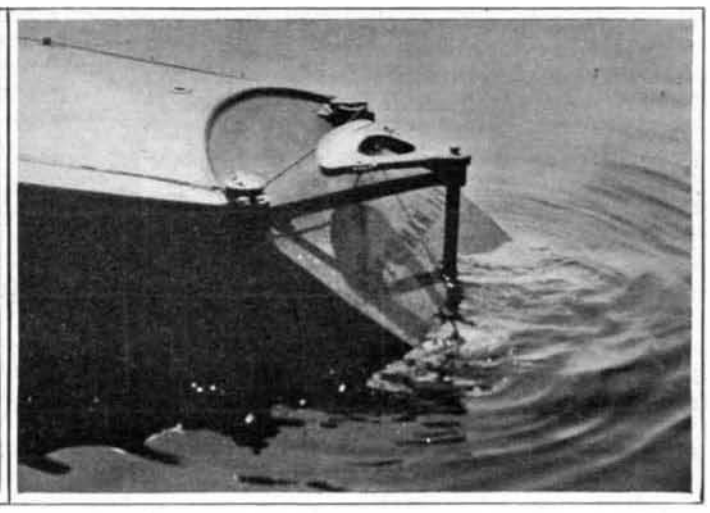
One of the most generally useful and popular of the many new types is that called "the ferry launch," of 50 to 80 feet length, fitted with at least a cabin for bad weather, if not with conveniences for a meal and a bed on occasion, with large comfortable cockpit, and having sufficient power to carry the owner and his family or friends from his home on the Sound or the Hudson to some New York pier at a regular speed of eighteen to twenty miles an hour or even higher.

The first step in this development has been through the engine. In France all the resources of the automobile builder—the highly-skilled engineer-designer, the chemist and metallurgist, the maker of fine steels and bronzes, the expert machinists, and fine machine

(Continued on page 170.)

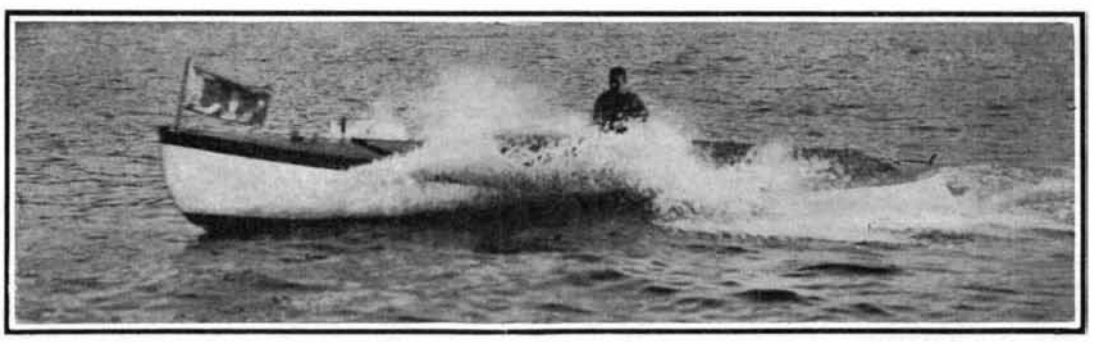


The 50 H. P., Twin-Screw, 60-Foot Motor Yacht "Katrina II." Speed, 13 Miles an Hour.

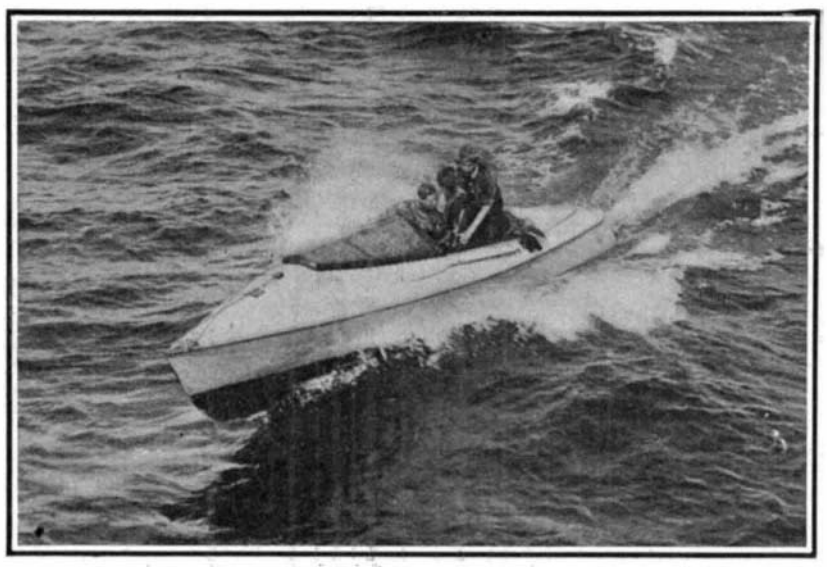


A Typical Racing-Boat Stern.

A Typical Cruiser. The 25 H. P., 46-Foot "Hazel."

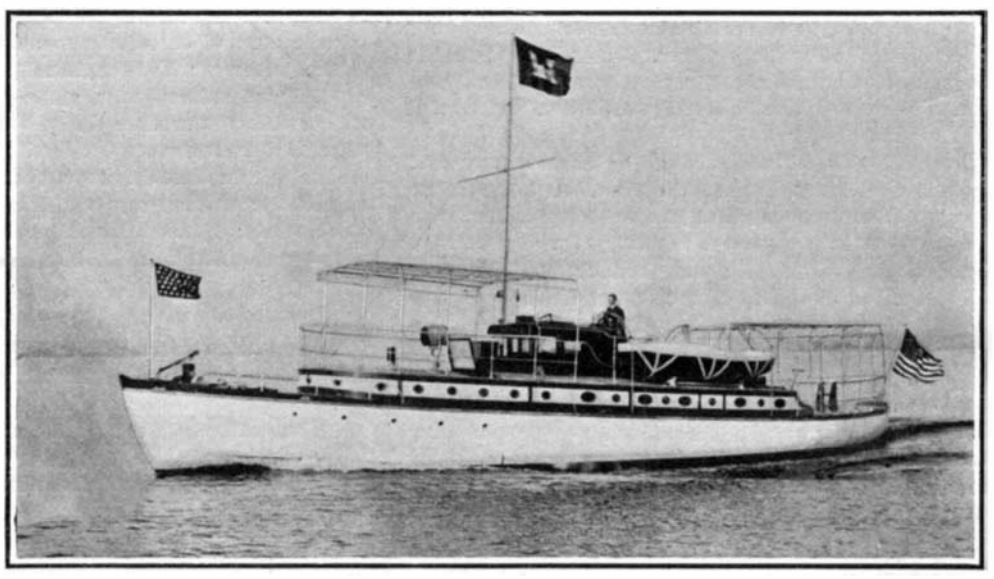


The 33½-Foot "Josephine." Her 36 H. P., Speedway Engine Has Driven Her at a Speed of 22.9 Miles per Hour.

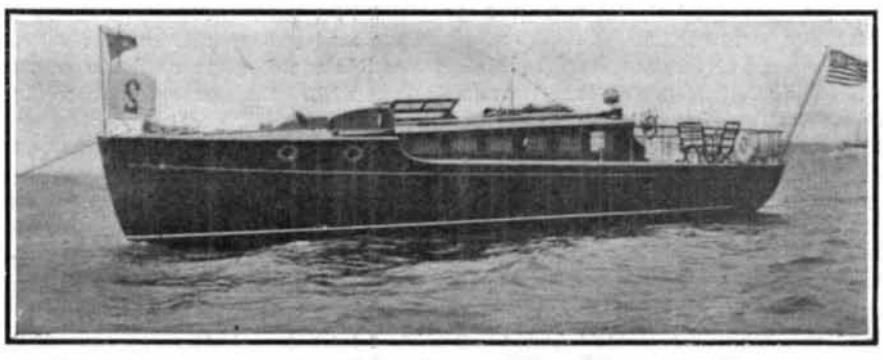


The 26¾-Foot Cruiser "Buddie II."

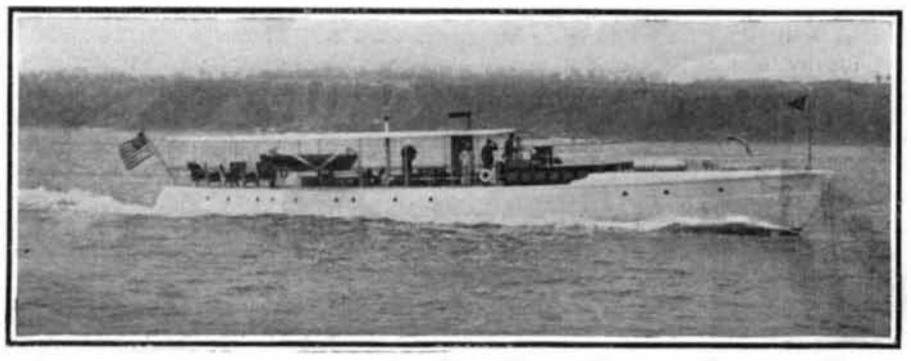
Photo copyright 1906 by Edwin Levick.



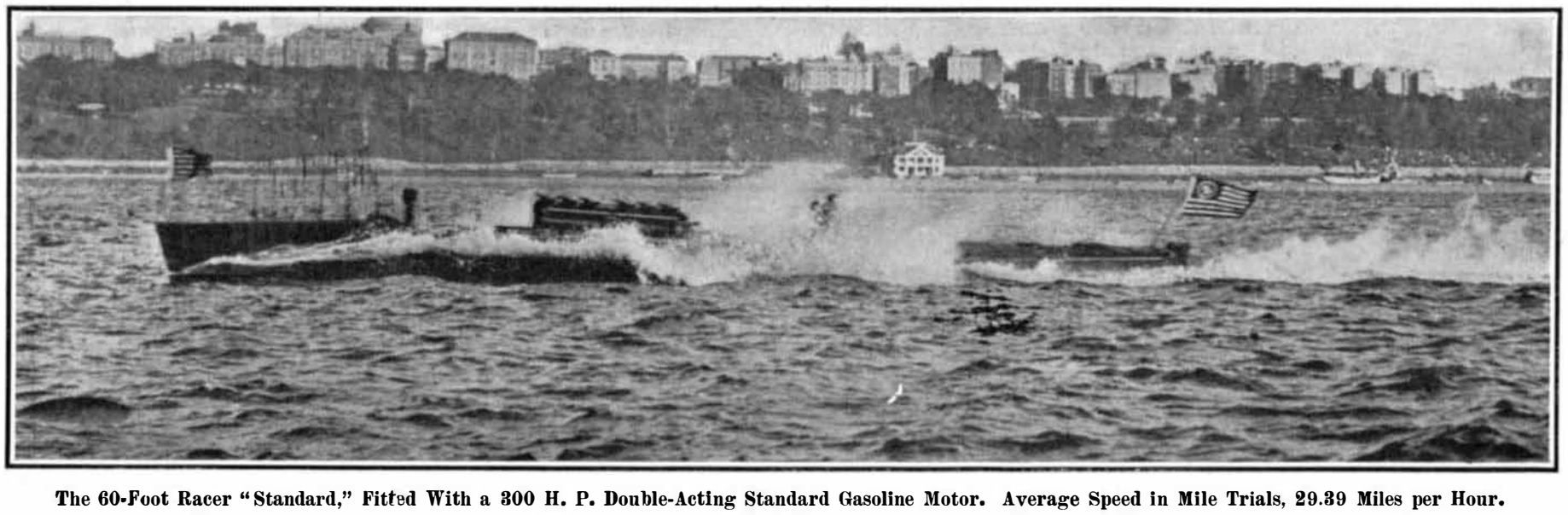
The 67-Foot, 50 H. P., Twin-Screw Coast Defense Inspection Motor Boat "Norka." Speed, 14 Miles per Hour.



The 36-Foot, 30 H. P. Cruiser "Unome," Which Reached College Point First in the Race Last Year from Marblehead, Mass. Average Speed, 9.5 Miles per Hour.



The 90-Foot, Twin-Screw, Gasoline Motor Yacht "Dodger" Driven by Two 300 H. P. Standard Engines. This Boat is Said to Have Reached a Speed of 25 Miles per Hour.



The 60-Foot Racer "Standard," Fitted With a 300 H. P. Double-Acting Standard Gasoline Motor. Average Speed in Mile Trials, 29.39 Miles per Hour.

VARIOUS TYPES OF MOTOR BOATS.

NEW TYPES OF GAS ENGINES FOR MARINE WORK.

BY COMMANDER A. B. WILLITS, U. S. N.

The four-cycle principle is the most perfect one in theory and practice. Here the explosion of a charge performs its expansion and works completely to the end of the first stroke. It is then exhausted and expelled by the return of the piston through the entire second stroke, while the third stroke draws in fresh mixture, which is compressed on the fourth stroke ready to be exploded at the beginning of the next. Here there is certainty of obtaining a full charge of the mixture in the proportions delivered through the carbureter, and both the increased reliability of action of this type and the decreased fuel consumption per horse-power are positive and marked. It is the type used in nearly all of the automobile engines built, and, in the marine-motor field, is the type along which high powers are being designed.

The Bureau of Steam Engineering has taken keen interest in the current advances in this class of motive machinery, and has had its representatives witness the tests of the latest types with a view to the opening for such installations in torpedo boats when the fuel question is less uncertain. Already there are fourteen gasoline and gas motors installed in naval small craft and eight others waiting completion of hulls. Besides these, motors for light-powered boats for torpedo craft have been designed and are being built under the Bureau's directions at the Norfolk yard. The question of replacing the machinery of some of the torpedo boats by explosive-mixture motors is still under advisement, and nothing is being lost through lack of keeping in touch with the latest developments. The naval installations thus far are as follows:

		H. P.
"Adder," submarine	Otto 4-cycle,	160
"Grampus," submarine	Otto 4-cycle,	160
"Moccasin," submarine	Otto 4-cycle,	160
"Pike," submarine	Otto 4-cycle,	160
"Porpoise," submarine	Otto 4-cycle,	160
"Shark," submarine	Otto 4-cycle,	160
Sixty-foot Indian Head ferryboat	"Standard" 4-cycle,	300
Yard ferryboat, Portsmouth, N. H.	"Standard" 4-cycle,	300
"Sylph's" gig	"Standard" 4-cycle,	25
"Sylph's" tender	"Standard" 4-cycle,	12
"Maine's" 28-foot whaleboat	Jager 4-cycle,	10
Special 20-foot whaleboat, Norfolk	Godschalk 2-cycle,	10
Special 20-foot tender, Norfolk	"Standard" 4-cycle,	12
"Vesuvius'" 28-foot launch	Jager 4-cycle,	10
Total		1,639

Those awaiting completion of hulls are:

		H. P.
Submarine "Nine" (Fore River)	Craig 4-cycle,	250
Submarine "Ten" (Fore River)	Craig 4-cycle,	250
Submarine "Eleven" (Fore River)	Craig 4-cycle,	250
Submarine "Twelve" (Fore River)	Craig 4-cycle,	250
Seventy-five-foot ferryboat, Training Station, S. F., U. I. Works	4-cycle	250
Water barge, Mare Island, Union Gas Co.,	4-cycle	120
Water barge, Portsmouth, N. H., (2) Globe, 100 each,	4-cycle	200
Total		1,570

It is seen by the above that 300 I.H.P. is the largest size motor thus far purchased by the government, and this installation in the 60-foot launch built for service between Indian Head and Washington stood a most satisfactory trial and gave excellent performance. This is a single-acting, six-cylinder, "Standard" gasoline motor. It is of light construction, and its peculiarity is that it is started as well as reversed by means of compressed air and a single movement of a cam-shaft lever, exactly as if handling an ordinary reversing link motion. Compressed air to 250 pounds per square inch is primarily pumped up into two air tanks running along the side of the engine room, by means of a small auxiliary, 1-horse-power gasoline engine driving an air pump for the purpose, this engine being also intended to drive a bilge pump and small dynamo for lighting and charging storage battery. Only the three after cylinders are connected to compressed air, and when the reverse lever is thrown to the first notch away from center, either forward or back, the cam shaft is shifted along to such a position as will bring cams to operate the compressed-air valves on these three cylinders, and to lift the exhaust valves on same once every revolution, instead of every other revolution. The three forward cylinders operate always on gasoline, the cam shaft shifting governing the rotative direction of the engine only. The three after cylinders are now operated by opening the compressed-air throttle valve, and the instant the engine starts and makes two or three revolutions, the lever is pushed on to the next notch, which cuts out the compressed-air valves, and adjusts the cams to trip the valves in a regular, four-cycle sequence. Practically, the handling of this motor is very simple, there never being a minute's hesitation in the action of the engine or the result on the boat, as the motor jumps to full speed

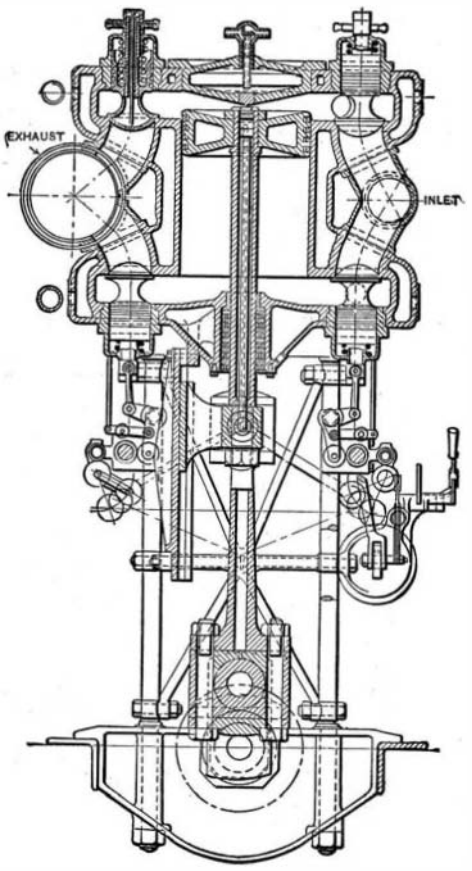
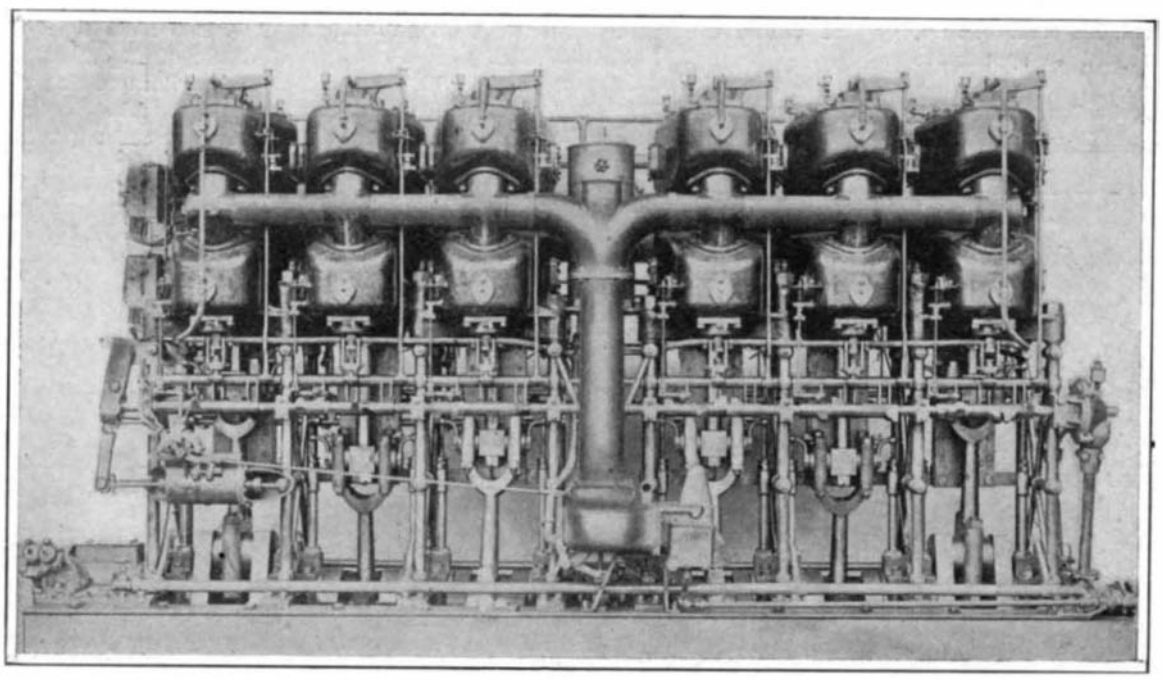


Fig. 1.—Vertical Cross-Section of Double-Acting Four-Cycle Gasoline Engine.

almost instantly. While running, an air pump or compressor, attached to the main-engine shaft, keeps the air supply up in the tank, but can be shut off at will. There is no difficulty in keeping up pressure for weeks at a time in the tank, and in reversing there is usually but a drop of about five pounds in the pressure.

There will be no future for the single-acting motor for large powers in marine work. The manifest advantages in the matter of weight and arrangement for variations in cruising powers, as well as in greater effectiveness in distribution in the double-acting type, will make it unquestionably the only one to be considered in the development of this class of machinery for sea-going craft. The difficulties at first experienced in arranging for the proper cooling of pistons and rods, and in devising efficient packing for the rod stuffing boxes, have been overcome, and, as before noted, examples of double-acting gasoline motors of 500 horse-power are already in satisfactory operation afloat.



A 6-Cylinder, Double-Acting, Standard Marine Gasoline Engine of 500 Horse-Power.

The cylinders of this engine are of 12½-inch bore and stroke. A 1000 H. P. engine with 16x16-inch cylinders is under construction.

A NEW TYPE OF GAS ENGINE FOR MARINE WORK.

It will be seen from Fig. 1 that the valves are positively operated, water-cooled, and balanced. The pistons are cooled by water circulating through the crosshead, up a tube in the piston rod, providing a return circuit around this tube. The reversing of the engine is similar to that described for the 300-horse-power motor for the Indian Head boat, except that a regular reversing controlling cylinder is used with compressed air instead of steam, bringing the reversing under perfect control. Means can also be provided by which, with one motion of a lever, all the lower exhaust valves can be lock opened and all the lower inlet valves can be lock closed instantly, thus changing the engine at once to a single-acting six-cylinder motor, or, in other words, cutting down to half power with one movement and without any substantial decrease in economy. Furthermore, the two units of three cylinders each can be unclutched so that the after three cylinders can be operated alone single acting, which actually reduces the power to one quarter of the original. Taking these points into consideration, together with the fact of being able (with a liquid primary fuel) to get under way at a moment's notice under full power and maintain absolute regularity of speed as long as the fuel lasts, there seems to be little more to be desired toward securing an ideal marine motor, and, even should producer gas be used, the same control of the variations of the power is maintained, although the ability to instantly start from cold port conditions is not secured, there being, of course, some delay in getting the fire properly under way in the retort.

Many of the details of the construction of this 500-horse-power double-acting motor are shown in the photograph and are extremely interesting to the naval engineer. In Fig. 2 the inlet side is shown, the carbureter (overflow type) being in the middle and placed low down, and directly controlled by the throttle-valve lever at the reversing cylinder on the left. The inlet valves for compressed air are on the back, and not shown, but are merely applied in this type to the lower ends of the three after cylinders, so that the three upper ends of these cylinders and the entire three forward cylinders are constantly "on" gasoline, either in the go-ahead or backing position of the cam shafts; and, as the sparking continues in all cylinders during the action of reversal, the very moment the compressed air starts the engine in reverse the other cylinders immediately take up action with gasoline, and the engine is running on explosive fuel immediately, so that the action of the compressed air is not practically more than the shifting into reverse motion and starting the engine in the desired direction. The moment this results the reverse lever is shifted to the full-throw notch, which restores the lower ends of the after cylinders to gasoline. This reversal is practically instantaneous. All the cam shafts are positively driven by gearing from the main shaft, and, consequently, the adjustments of the cams are exact, and the tripping of the valves in this arrangement is accomplished almost noiselessly.

The lubrication of this motor is also a very interesting feature. Forced feed with sight-feed adjustment is accomplished through plunger boxes shown on the after end of the motor, the upper box being for delivery to the center of each cylinder, and the lower box for delivery to the middle of the piston-rod stuffing boxes, the plunger pumps for each of the small pipes being worked by a lever with a small connecting rod to a pin on the end of the exhaust-cam shaft, which gives sufficient rotary motion for the desired lift, the lift being also further regulated by a slot in the plunger lever, to which the connecting rod is attached. The lubrication for the crossheads and crank pins is accomplished by a small plunger pump worked by a gear at the forward end of the exhaust-cam shaft, similar to the gasoline pump shown at the forward end of the inlet-valve cam shaft in the photograph, the oil being kept in a constant flow from the crank pit into which it falls, up through a strainer box between the two sets of three cylinders (and just seen in the photograph), back of the middle branching of the inlet pipe, and fed by gravity from this tank to the journals; a surplus of oil being constantly circulated by this method and kept constantly strained without waste. The journals are of ample dimensions and give no trouble whatever from heating with this system of lubrication.

Another important feature in this installation is that connected with the circulating water. As the boat is designed to run in salt water, there has been a connection made by an ordinary keel condenser between a small fresh-water tank inboard and the circulating-water pump, this latter pump being a slow-moving one

of ample dimensions worked by direct gearing on the main shaft. It is found by this means that ample cooling water can be maintained from a very moderate original supply of fresh water, and the objectionable features of having salt-water circulation are entirely obviated. Unquestionably this will be an important factor in all salt-water installations of this kind, and will greatly add to the endurance and protection of the outfit. Where the circumstances make a keel condenser in any degree objectionable, a regular tube condenser (more properly a cooler) can be adopted with circulating pump for it, and secure ample provision for the work.

In the boat inspected containing this motor, an independent installation of a small 4-horse-power "Standard" motor was made for the purpose of driving a dynamo for lighting the vessel and charging storage battery, a bilge pump for constant use, an air compressor for pumping up the compressed-air tanks whenever necessary, and a small magneto for sparking. This auxiliary is not necessary to use except when particularly desired, as, when the main engines are in operation, the air supply is kept up in the tanks by attached pumps, and it is easy, of course, to attach bilge pumps to the main shaft, so as to permit disuse of the auxiliary engine, except at night.—Journal of the American Society of Naval Engineers.

A HIGH-SPEED MOTOR BOAT THAT CAN BE BUILT AT HOME.

The illustrations shown herewith depict the Brooks Boat Company's "No. 13," as viewed from the front, rear, and side when traveling at high speed through the water. When the fact is considered that this boat was claimed to be going 28 miles an hour when the photographs were taken, one can readily see that the model of hull used is a good one, and one that throws but little spray when compared, for instance, with the "Standard," shown at the bottom of page 168. Fitted with a 60-horse-power, six-cylinder Sterling engine, "No. 13" is claimed to have made a measured mile in 2 minutes 8 seconds last summer, which would be at the rate of 28.12 miles an hour. As the photographs show, this boat looks every inch a racer, and appears from the shape of the hull to be capable of attaining the speed claimed. It is 39 feet 7 inches in length by 5 feet beam, with a depth of hull at the bow, amidship, and at the stern of 31, 29, and 19½ inches, respectively. The draft depends upon the size of propeller used, as the hull is made flat at the stern, so that it glides nearly on the surface of the water.

The builder of the above-described speed boat is one of the oldest boat-building concerns in this country. This company not only builds boats, but also makes a specialty of furnishing frames complete, with all the necessary material for putting them together and with patterns for cutting the planking. When supplied with all this material and instructions, which can be had at relatively small cost, the amateur can build himself a boat during leisure hours, knowing that when it is completed, his craft will not be an experiment either with regard to appearance or speed.

Besides the racer shown, the Brooks Company builds, or supplies frames for, several smaller speed craft, among which are a 30-foot racing boat claimed to make 16¼ miles an hour with an engine of 10 horse-power, and a 22-foot speed launch, claiming also 8½ miles an hour with a 2-horse-power motor, and which should therefore make as high as 12 miles an hour with 6 to 8 horse-power. Still another interesting model is a stern-paddlewheel boat, which can be built in varying sizes from 25 to 40 feet in length. This boat can be built as an open or closed launch or as a boat for freighting purposes on shallow lakes or streams. Equipped with a 7 to 12 horse-power motor, it will attain a speed of from 6 to 9 miles an hour.

Bow View, Showing Wave Formation.

Stern View, Showing Wake.

The Brooks "No. 13" Making 28 Miles an Hour.

A RACING MOTOR BOAT FOR AMATEUR BUILDERS.

Cupro-nickel, says the Brass World, is used for two purposes: In the manufacture of bullet jackets and in the production of five-cent pieces. Bullet jackets consist of 80 per cent of copper and 20 per cent of nickel. The five-cent pieces made by the United States government are composed of 75 per cent of copper and 25 per cent of nickel.

INFLUENCE OF THE AUTOMOBILE ON LAUNCH DEVELOPMENT.

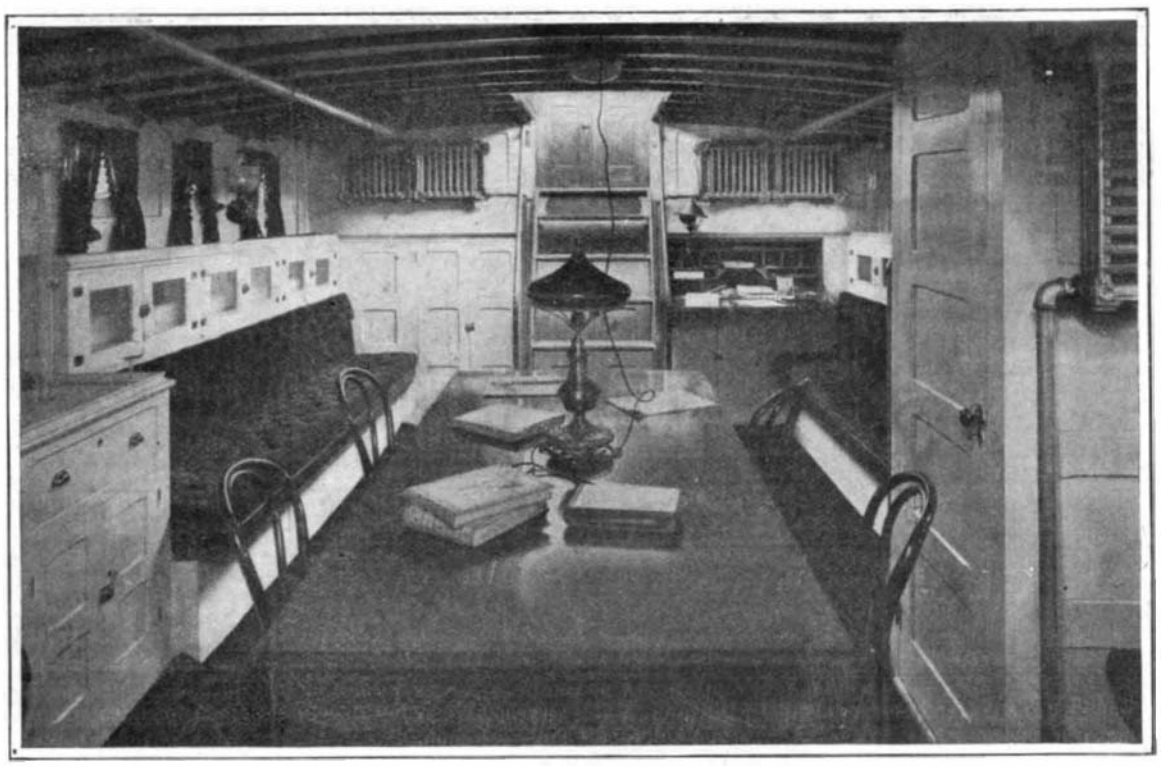
(*Concluded from page 167.*)

tools—have been utilized in the production of engines of phenomenal lightness, up to 300 horse-power or higher, and especially designed for launch installation. At the same time every improvement in the automobile world in the line of carbureters, ignition devices, lubricators, etc., has been transferred to the marine engine.

In this country, under somewhat different conditions of manufacture, the builder has had on the one hand his old, heavy, slowly-turning engine, and, on the other, the French automobile and auto-marine engines, of wonderful refinement and lightness. The result is seen in several magnificent machines in the larger sizes, purely of the marine type, with the skeleton framework of the steam torpedo-boat engine, light and powerful to an extent not dreamed of five years ago, with all the latest advances in gas-engine practice and electrical science making them as reliable and practically as flexible and tractable as the steam engine. Every development of automobile engineering in the line of better materials, finer tools, and improved methods has gone to further the perfection of the marine engine.

But the full measure of advance is not to be gaged solely by such costly machines as the double-acting, six-cylinder engine of 500 horse-power, started and reversed by compressed air. The improvement begins with the smallest and cheapest of the two-cycle engines, where better materials, improved design, standard tools of greater accuracy, and more scientific carbureters and ignition devices, have raised the standard and decreased the relative cost. Throughout the whole range of heavy engines, still in demand for much of the yacht work and in fishing and working vessels, there has been a general improvement along the same lines. Next to these stands a new class of launch engines of varying sizes from 20 to 80 horse-power, mostly of high speed as compared with the old type, but far lighter, more compact, practically as strong and durable, and superior alike in reliability and economy.

With the improvement of the engine and the multiplication of types and sizes has come a reconstruction of the entire power pleasure fleet on new lines. Limited no longer to a few sizes of engine of a single type, the yachtsman and his designer have been free to plan a great variety of new craft. For day use there are launches of comparatively high speed of from 20 to 80 feet; for ordinary pleasure running there are comfortable and convenient craft of good speed, easily handled by one person and safe in any ordinary weather. Where cruising is the main object, the reduction in size and weight of engine has brought about a corresponding change in the refinement of the hull, which is no longer a homely box from which a speed of but six or seven miles per hour is expected, but is as handsome and graceful as a sailing yacht, with double the accommodation on the same length, and with a speed of at least a dozen miles. Still another new type is the rough-water cruiser, from 30 feet upward, including the 40-footers that raced around Cape Cod in 1905 and 1906 and the 40 to 60-footers that will race to Bermuda this year. While for this special work the old type of heavy engine still takes precedence of all others, the development of this most useful and interesting class may be traced back directly to the autoboat racing of two and three years ago—a reaction and a protest it is true, against the extreme racing type, but nevertheless owing its origin to it.



Cabin of the U. S. Coast Defense Inspection Boat "Norka," Which is Noteworthy for Its Roominess and Comfortableness.

A TYPICAL MOTOR-BOAT INTERIOR.

CANOVETTI'S AIR-RESISTANCE EXPERIMENTS.

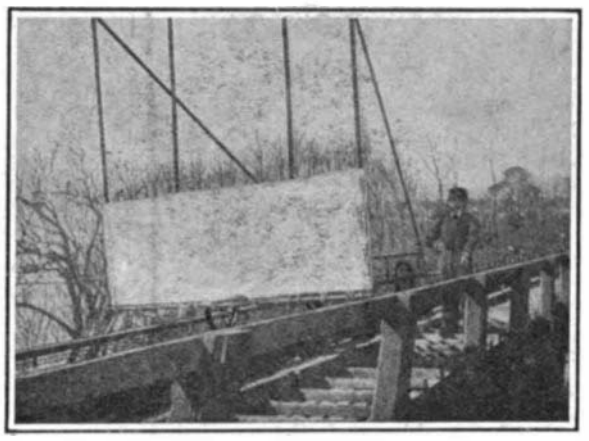
BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

In view of the great activity which we find at present in the line of aeroplanes and airships of different forms, the study of the resistance which the air offers to moving bodies becomes one of considerable importance. This question is also of interest in the design of high-speed trains or automobiles and in another field, in the design of projectiles for artillery. Newton was the first who formulated a series of laws for air resistance, supposing that it is produced directly by the inertia of the molecule of air as acted upon by the moving body. But this hypothesis is far from being in accord with what happens in reality, and the laws which result from it

are only good within certain limits, and then approximately. Following him, Euler brought out another theory which comes nearer the practical conditions but without corresponding with them completely. On account of its great elasticity, the air gives rise to phenomena which are not to be foreseen by theory. It acts differently according to the speed of the moving body. Up to a speed of 800 feet per second the velocity follows a certain law, and after that it departs considerably from this law. It is difficult to establish any sure data of this value of air resistance for various shapes of bodies, and in spite of the experiments which have been made hitherto in this direction, we may say that the question is far from being completely solved.

An important contribution to this subject is the recent work of the eminent Italian engineer Canovetti. The experimental work which Signor Canovetti has been carrying out of late concerning the question of air resistance to bodies moving at a high speed is of great interest. The first experiments which Canovetti undertook were made at Brescia in 1897 and from the commencement they proved highly successful. To carry out the tests, he used a steel cable of small diameter which was stretched from the top of the Castle of Brescia, a structure of considerable height, some 260 feet, down to the ground at an easy slope of about ten degrees. The wire was tightly stretched so as to give a nearly straight path, and upon it was made to run a two-wheeled carriage, transporting the body upon which the experiments for air resistance were to be made. The bodies were hung below the carriage, and were variously shaped. For instance, one or two circular disks were formed of a metallic hoop with canvas stretched upon it. Where a pair of disks were used, these were placed one behind the other and at different distances. The researches were carried out with special reference to the forms of the bodies and the speeds which would have a direct application in aerial navigation, either for aeroplanes or elongated balloon bodies such as are used for airships.

Since the first experiments were made, Canovetti desired to carry on another series of researches, but on a larger scale. This he had an opportunity of doing, for the Como Brunate inclined plane, which runs up the mountain slope, was put out of working order by a series of repairs which had to be made, so that Canovetti found that he could make use of the inclined tracks for carrying out his new experiments, and thus means were at hand for making these tests upon a much larger scale both as to distance and size of the apparatus than before. In this work he received aid from the Accademia dei Lincei which enabled him to carry it out in a very thorough manner. To this end he had built a four-wheeled carriage frame of light and strong steel tubing, so as to run upon the rails of the track. Mounted at the front end of the carriage is a large square frame of bamboo upon which is stretched a cloth covering having a total surface of ten



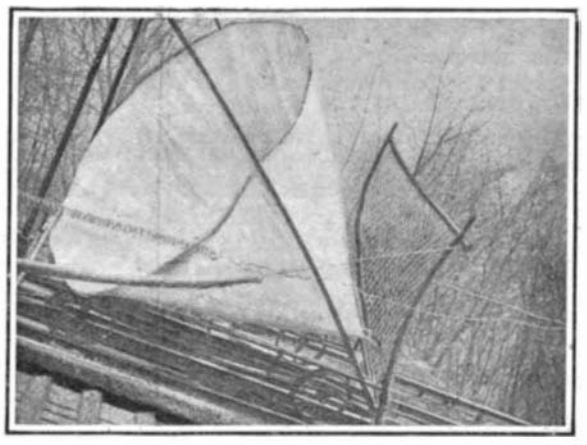
Canovetti's Car on Track With Air-Resistance Frame Using Small Amount of Canvas.

square yards. In the center of the carriage are placed two ballast carriers in the shape of steel cylinders which can be loaded with small lead weights to the extent of forty pounds for each cylinder or a maximum of eighty pounds for the carriage. The total weight of the latter is about 160 pounds. The apparatus thus constructed is taken to the top of the incline and allowed to run down the slope by its own weight. At the bottom of its course the carriage is stopped by a metallic network which is stretched upon a properly designed frame and is rendered elastic by a system of springs and counterweights so that the carriage is stopped without too much of a shock. Starting with the square frame a number of other frames having different forms are used, such as a flat round disk, a conical form, and others. When using the square frame and varying its surface from ten to two square yards, and at the same time varying the weight on the carriage, the latter was found to take different and increasing velocities each time, and the speed of travel was measured and registered very accurately by means of an electric device. A series of contacts are placed along the track, spaced about eighty feet apart, and the contacts are connected with the registering station at the foot of the slope. Here are placed a set of apparatus which have been specially designed for this purpose and upon which is observed the exact course of the carriage at any given moment. The registering instrument consists of a double Morse register, and the paper strip which is unrolled at a regular rate contains two sets of punctures. The first series of dots are made at regular intervals by means of a clock, while the second set lying alongside the former are formed by a needle-point on the armature of an electro-magnet through which current is sent from the contacts lying along the track, and when the car passes over a contact a dot is formed on the paper, thus giving an exact record of its passage, and the time can be measured by comparing with the set of chronometer dots. Upon the data which are thus obtained Sig. Canovetti makes the necessary calculations for finding the air resistance and the laws which govern the latter.

After the experiments were made with different forms of flat planes, a new series of data were obtained by using a cone-shaped frame covered with canvas. First the cone was placed with the pointed end in front, and next the point was placed in the rear, in order to show the effect of the air resistance upon the body of an airship. These experiments have a close analogy to the researches which are made upon various forms of hulls of vessels in a naval testing basin. Another series of tests which are likely to be of great value are those which Sig. Canovetti is carrying out with the frame disposed as we find it in an aeroplane, in a flat or slightly inclined position, and this may throw some light upon the different conditions of balance and resistance which enter into this question.

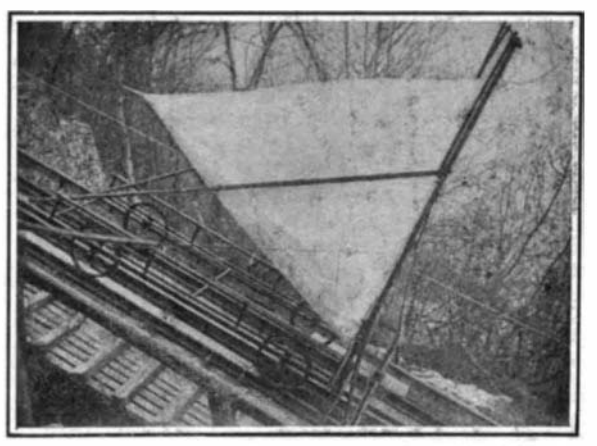
Spring Frame or Buffer for Stopping the Car at the End of Its Course.

Frame stretched with wire net and held by coiled spring.



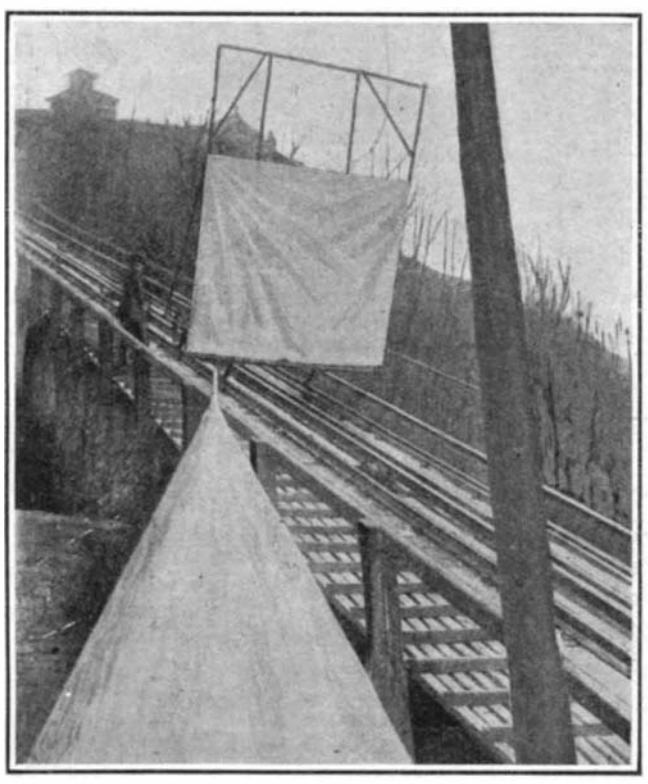
Car Running Backward.

Canovetti's car using a conical air-resistance piece (canvas-covered bag) coming to a stop on the spring mattress. Cone is small end foremost and bamboo frame toward rear.



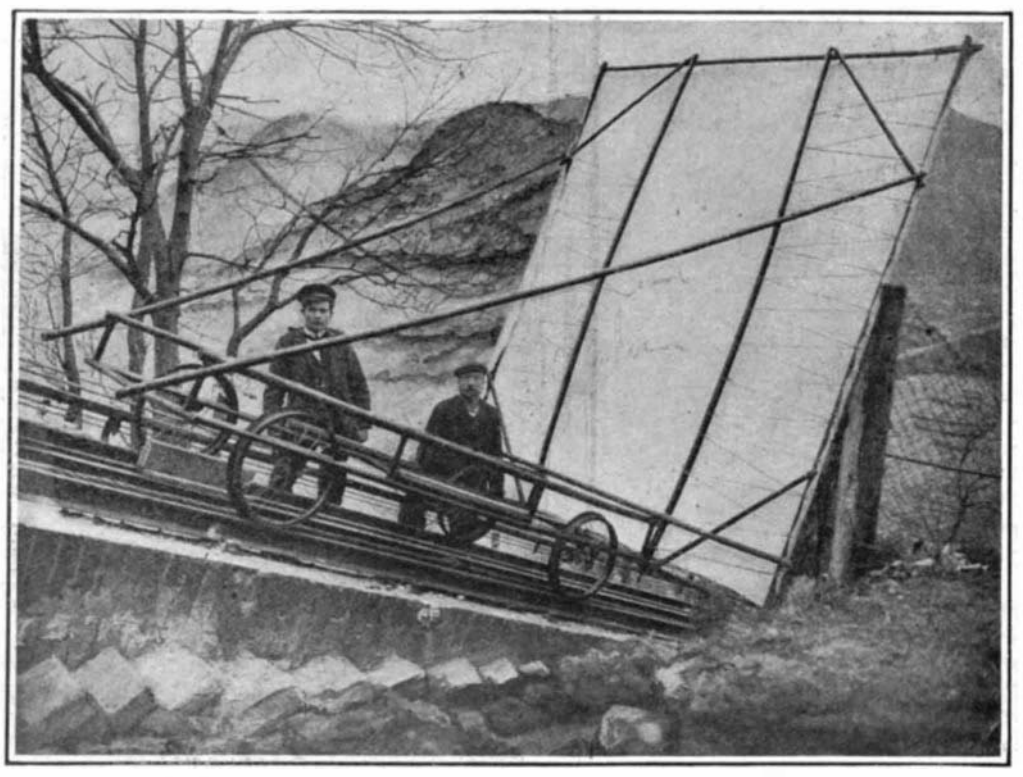
Same But Running Forward.

Car having same conical bag now placed against the bamboo frame, with the large end foremost.



Canovetti's Car on Down Grade to Test the Air Resistance.

The experimental bamboo frame is partly covered with canvas. In front is a separate conical canvas frame or bag for other tests.



Canovetti's Experimental Car Used on Inclined Track, Running on Rails for Air-Resistance Tests.

On the bamboo frame in front is stretched more or less canvas for different air resistances. Other shapes are used as seen in the illustrations, especially a conical shape, useful for gathering airship data.

CANOVETTI'S AIR-RESISTANCE EXPERIMENTS.

SOME NEW AND USEFUL ELECTRIC HAND TOOLS.

BY A. FREDERICK COLLINS.

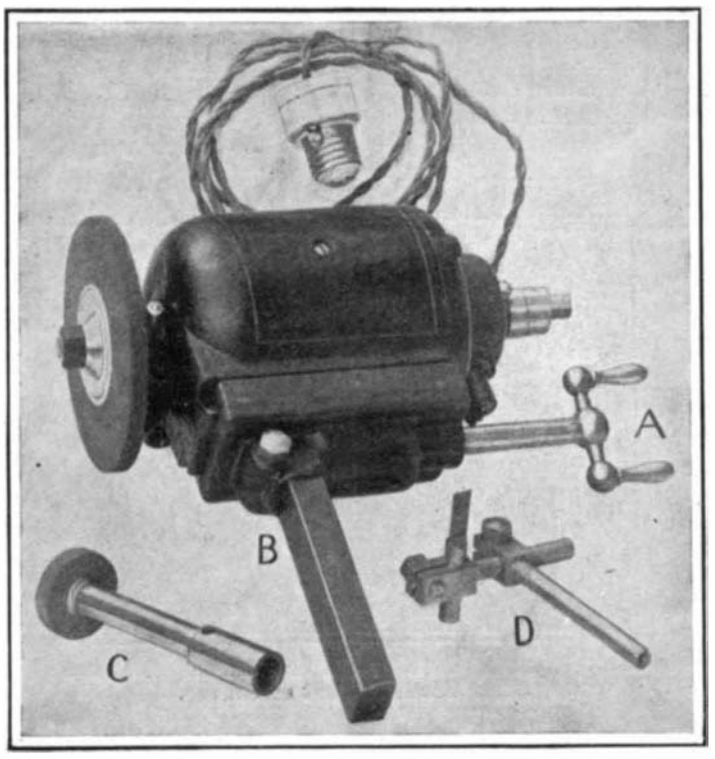
It is generally acknowledged abroad, according to Consul J. I. Brittian, of Kehl, Germany, that the Americans excel their foreign competitors in the manufacture of machine tools, due chiefly to their thorough knowledge of the industry and their aptness in meeting every possible requirement.

The above statement is fittingly justified by a new branch of the business, namely, that of building portable hand tools driven by electricity. There are several companies in the United States that have given special attention to the manufacture of these devices, some of which are illustrated on this page.

One company's latest development along this line includes an electrically driven bench drill suitable for small works, a portable electric breast drill and an electric buffing and grinding outfit for household use. The bench drill has been especially designed for the use of jewelers, chauffeurs, repair men, and manufacturers who have a large amount of drilling on small work and in other places where the drilling service is not too heavy and severe.

Machine and general repair shop men, as well as manufacturers, are becoming better informed and more convinced of the advantages of the electric motor for driving their machinery, and realize that the saving of both time and money are possible in just those operations for which the electric bench drill is designed. The bench drill shown herewith is furnished with a vertical motor mounted on top of a column sliding in a socket cast integrally with the base, in which it can be adjusted for various heights. The motor body or head is also adjusted radially for drilling positions.

The whole outfit rests on a broad base 6 x 10 inches which gives it the necessary stability. The minimum height is 16 inches when the motor arm is in the lowest position and the maximum height is 22 inches when the arm is fully raised, thus giving a range of 6 inches through which the motor body may be raised or lowered. The work is fed to the drill by raising the circular table, which is operated by a lever within a range of 1¼ inches vertically. The motor is series wound and can be supplied with 115 or 230 volt winding, for use on direct-current circuit only. A single gear reduction is provided between the armature shaft and drill spindle. The hand wheel mounted on the armature shaft at the top is convenient for turning the spindle and adds a flywheel effect to the spindle as well, giving a smooth and steady rotation to the drill. The amount of power required for the operation of the drill naturally varies with the work performed, but in no case is it excessive. The largest drill the chuck will hold is 21/64 inch in diameter and from this all sizes down to No. 40. The bearings are provided with self-oiling cups which require attention only every three or four months. The outfit includes a chuck of standard design, ten feet of attaching cord and an Edison plug.



Electrical Tool-Post Grinder.

The weight of the bench drill complete is about 40 pounds, enough to insure firmness and rigidity.

The new domestic grinding and buffing outfit illustrated has been put on the market especially for grinding knives, scissors, and other small edged tools, and for polishing silverware, jewelry, and other like articles. A grinding wheel of suitable character to insure a smooth cutting edge without the use of a sharpening tool is interchangeable with the buffing wheel. These outfits are adapted for the intermittent service required in the ordinary household but are not suitable for the heavier continuous work required by jewelers and dentists.

The household outfit consists of a motor with shaft extending two inches from the end of the bearing to the inside of the wheel, the necessary washers and nuts for holding the wheel in place, one rag wheel 3½ inches in diameter, one 3-inch emery wheel ½ inch thick, together with attaching plug and cord. These outfits are furnished for 110-volt direct or alternating current and can be especially wound to 220 volts.

The alternating-current motor weighs about 25 pounds, while the direct-current motor is much lighter, weighing but 15 pounds. Both motors are very simple, requiring no more attention than a fan motor. In connecting with a source of current supply the cord is attached to the binding post of the motor and the plug inserted in the nearest socket at which the proper current is available.

A Cincinnati company builds a number of portable electric hand-driven tools, including a number of grinding outfits for both external and internal work, radial and hand drills. The electrical tool-post grinder which we illustrate covers a wide range of work and is useful for grinding centers, cutters, reamers, dies, rolls, and the like, as well as for surface, parallel, and internal grinding jobs of all kinds.

The shank of the grinder is clamped in the tool-post of the lathe, the motor carrying on its shaft the emery wheel so that it may be set at any desired angle, in which case the wheel is moved across the face of the center to be ground by means of the handle, as the shank may be set in the tool-post of a planer, shaper, or milling machine, or it can be clamped in an ordinary bench vise. A flexible cord and attachment plug are connected and on securing the plug into any incandescent lamp socket it is ready for work.

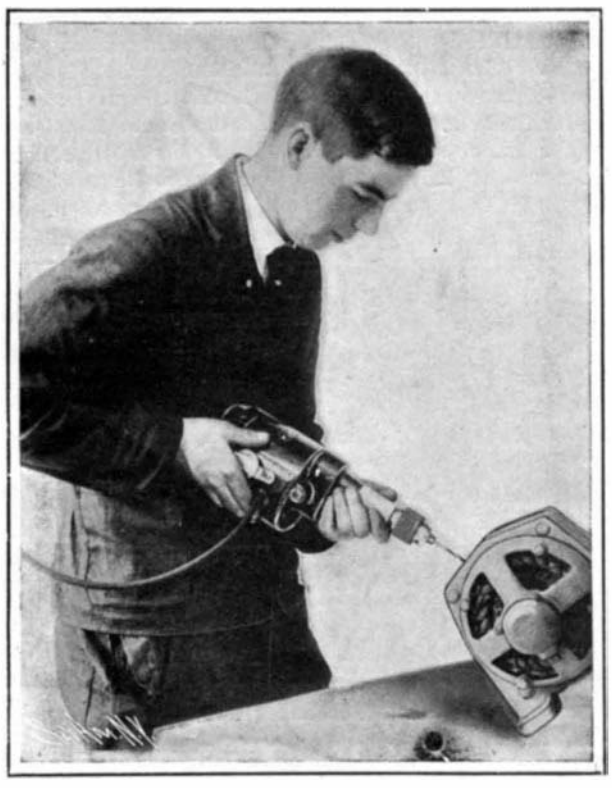
These portable grinders are usually wound for 110 or 220 volts direct current, though in special cases they are wound for 50 to 250 volts and also for alternating current. All parts of the motor are inclosed, making it dust-proof; the spindle carries taper cone bearings and the wear may be taken up by means of a unit on the rear end of the spindle, these being also provided with dust-proof caps. A V slide having a 3-inch travel by means of a worm through the handle *A* is fitted with a gib to take up the wear.

The shank *B* is of steel and is fitted to the hole in the V cap; it is held in position with a screw clamp so that different sized shanks can be used. The extension mandrel *C* is used for internal grinding by removing the regular wheel and screwing the mandrel to the spindle. A tool-rest *D* is a valuable attachment, serving as an index for grinding cutters, reamers, etc.; this detachable tooth-rest insures that each tooth of the cutter will be ground correctly.

Where the grinder is set in a lathe for internal grinding the larger wheel is removed and the extension mandrel is screwed to the spindle in its place. The mandrel *C* will grind a hole from ⅜ to 1½ inch in diameter. The grinder may be set in a milling machine and the cutter ground without removing it and the tooth-rest *D* may be used for indexing as previously indicated.

Attached to the tool-post of a planer it is invaluable for grinding surfaces and for heavy parallel grinding, such as rolls, journals, bushings, and all kinds of hardened work. Heavier grinders operating on ¼, ½, 1, and 2 horsepower are also constructed. In these latter types the bases of the angle plates are bolted in the tool-post rest of the lathe and it has a vertical adjustment to bring it in line with the centers.

A labor-saving hand and breast drill shown in one of the cuts is useful for drilling holes in wood or metal. It



The Portable Breast Drill Motor.

Grinding and Buffing Motor in Use.

Portable Electric Bench Drill in Use.

Method of Using Buffing and Grinding Motor.

is designed to be used wherever the old style hand drill can be used, and not only does it save the strength of the operator but it does the work many times more rapidly, for it is driven continuously and at a much higher speed. The motor is provided with a switch to start and stop it, so that it is absolutely under control at all times, and as the switch is located near the vertical handle it is within easy reach of the index finger. The chuck spindle is so arranged as to allow drilling on a line with the base of the motor and by this arrangement angle and corner drilling are possible.

The drill shown in the cut has two speeds operated by means of the lever on the front end of the motor and with this useful arrangement a slow speed for large drills may be used or a faster speed for smaller ones. These electrically driven tools are without doubt the most powerful and compact machine tools ever built and their extremely light weight makes them especially desirable for all classes of small work.

LEATHER GOODS MADE OF HUMAN SKIN.

BY M. GLEN FLING.

It is a fact well known to a very few skilled workmen, and not known at all to the world at large, that human skin can be prepared, tanned, and made into durable articles quite as successfully as can the skin of our four-footed friends. You can say over and over again to yourself that there is really no reason why human skin should not be so utilized, and you can be told by the workmen who handle it that there is nothing gruesome in the work; you can reason and argue with yourself about the matter, and try to be "matter-of-fact and sensible," and still there will be little shudders running through you and creeping up and down your spinal column at the thought of having the skin taken from a human body and made into some article of wearing apparel.

The only way to overcome this sensation, if you want to get over it, is to examine some of the articles made from the skin, and you will find that the leather is very much like dogskin or pigskin.

Mr. William Hansell, of Philadelphia, has the largest article which has ever been known to be made from human skin. He was particularly fortunate in getting enough of one grain, and succeeded only after a long and systematic search. The article is a beautiful pure white saddle, and any one examining it would be at a loss to tell the kind of skin from which it is made. When you are told, you realize that the pores which show have a familiar look; but when you are given a bit of the skin, of which Mr. Hansell has retained a few samples, you are amazed at the thickness. Three layers of skin you know you have, but knowing how easily a needle prick will draw blood, you are astonished to find what a good thick covering these three thicknesses make. This saddle is made from the skin of one man. A woman's skin, generally speaking, would be too delicate.

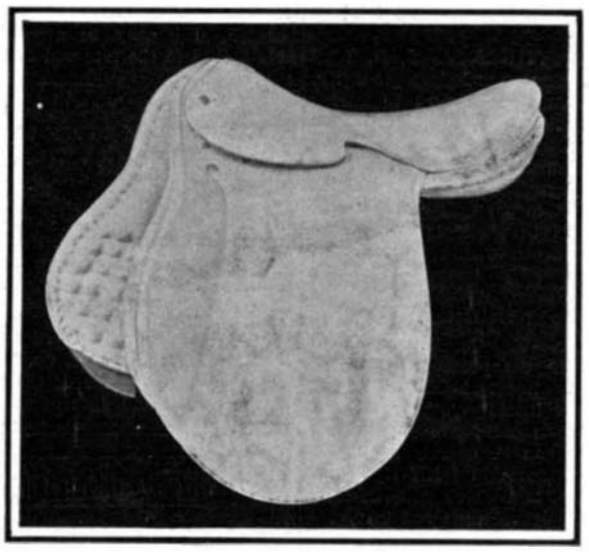
Now, it is not to be supposed that there is a general trade in human leather. Human skin is an exceedingly rare article. Sometimes a physician will have a piece, made into a cover for an instrument case, and occasionally medical students get enough to be made into a purse or a pair of slippers. Patients sometimes have a belt or a book cover or some such article made from a limb which has been amputated. It seems a peculiar mind that would take pleasure in "souvenirs" of this order.

The wearing public are not alone in their aversion to the use of human skin for the purposes to which they unhesitatingly put the hides of animals. It is very hard to get workmen to handle the "leather." Mr. Hansell gave his piece of skin, after it had been tanned, to an old workman who had always made up all his leather goods, and told him to make it into a saddle.

Three weeks the workman kept the skin, and one day he brought the partly finished saddle to Mr. Hansell with some question about finishing. "By the way, Hansell," he remarked as he was leaving, "I wish you would tell me what this skin is. It is the most contrary stuff I ever worked with; it's worse than pig or goat skin."

Very injudiciously Mr. Hansell informed him that it was human leather. At that the workman dropped the half-finished saddle, and left without a word. He never returned, and nothing would induce him to finish his job. Mr. Hansell, after waiting three months, hoping he would change his mind, turned the unfinished saddle over to another workman, but he took good care not to tell him what kind of leather the "contrary stuff" was.

The work of tanning human skin is pretty much the same as that of curing any other skin. Curiously enough, tattooing goes through the epidermis to the under skin, and not a little of the tanning of human skin is done for the purpose of preserving the designs tattooed upon it. Human skin may, however, be tanned with the hair on it, in which case the epidermis is not removed. Scalps so tanned are said to make the best wigs known, and because the tanning is done with alum instead of with oils, as is the case with furs and most of the hair-covered skins of commerce, the resulting leather is much more durable.



A SADDLE OF TANNED HUMAN SKIN.

HUGE BOWLDERS RAISED BY BUCKET DREDGES.

The dredging operations which G. S. Mayes is carrying out for the Dominion government in Sand Point slip of the west side of St. John harbor are presenting difficulties which it is safe to say were not altogether anticipated by the contractor when the work was started.

From a spot to the north of berth No. 2 an area 600 feet wide and extending northwest toward the junction between North Rodney Wharf and Union Street, has been found to consist of immense bowlders varying in weight from nearly 100 tons downward. Firmly imbedded in the mud, which in places covers them to a depth of 40 feet, the rocks have proved extremely difficult to handle, and the time spent in enabling the dipper of the dredge "Beaver" to obtain a correct balance beneath one of the giants frequently runs to hours.

The picture showing a bowlder being raised in the dredge's bucket gives a good idea of the work. The bowlder weighs about 30 tons, and when raised to the surface was found to be lodged endways in the bucket, and jammed so that it could not be removed without considerable delay and trouble. The bucket, it may be

THIS BIG BOWLDER, WEIGHING 30 TONS, WAS DREDGED FROM THE HARDPAN IN 60 FEET OF WATER IN ST. JOHN HARBOR, NEW BRUNSWICK.

mentioned, is 6 feet 2 inches in diameter and is 9 feet 2 inches at its deepest part.

But this bowlder was greatly exceeded by one measuring 12½ by 12 by 7½ feet and weighing about 92 tons, which was raised by the same means. It was dug at a depth of 60 feet below high-water mark. The dredge was then moved, with the stone in the bucket, about 150 feet, when the stone was deposited.

In the prosecution of the work the greatest difficulty has been found in digging out or unearthing of these bowlders, as the material they are found in is marl or hardpan, which is next to impossible to dig. The work has involved the destruction of ten large spuds or anchors, 80 feet long, 38 inches square, incased in heavy iron, as well as the breaking of three heavy steel dippers and three 16-ton dipper handles. The main engines of the dredge are two 24 x 24 cylinders geared up to 1 to 14, so that tremendous power is exerted to remove the bowlders, bedded as they are in such tough material. Another great difficulty is that the abnormal rise and fall of the tide, which frequently reaches 29 feet, makes it difficult to carry on the work at high and low water.

Effect of Duration of Stress on Strength and Stiffness of Wood.

It has been established that a wooden beam which for a short period will sustain safely a certain load, may break eventually if the load remains. For instance, wooden beams have been known to break after fifteen months under a constant load of but sixty per cent of that required to break them in an ordinary short test. There is but little definite and systematic knowledge of the influence of the time element on the behavior of wood under stress. This relation of the duration of the stress to the strength and stiffness of wood is now being studied by the Forest Service of the United States Department of Agriculture at its timber-testing stations at Yale and Purdue universities. The investigation should determine: The effect of a constant load on strength; the effect of impact load or sudden shock; the effect of different speeds of the testing machine used in the ordinary tests of timber under gradually increasing load; and the effect of long-continued vibration.

To determine the effect of constant load on the strength of wood, a special apparatus has been devised by which tests on a series of five beams may be carried on simultaneously. These beams are 2 by 2 inches in section and 36 inches in length, each under a different load. Their deflections and breaking points are automatically recorded upon a drum which requires thirty days for one rotation. The results of these tests extending over long periods of time may be compared with those on ordinary testing machines, and in this way safe constants, or "dead" loads, for certain timbers may be determined as to breaking strength or limited deflections. The experiments of the Forest Service show that the effects of impact and gradually applied loads are different, provided that the stress applied by either method is within the elastic limit of the piece under test. For example, a stick will bend twice as far without showing loss of elasticity under impact, or when the load is applied by a blow, as it will under the gradually increasing pressure ordinarily used in testing. The experiments are being extended to determine the relations between strength under impact and gradual loads.

Bending and compression tests to determine the effect of the speed of application of load on the strength and stiffness of wood have already been made at the Yale laboratory. The bending tests were made at speeds of deflection varying from 2.3 inches per minute to 0.0045, and required from twenty seconds to six hours for each test. The woods used were longleaf pine, red spruce, and chestnut, both soaked and kiln-dried. From the results are obtained comparable records for difference in speeds in application of load. A multiplication of the results of any test at any speed by the proper reduction factor, derived from these experiments, will give equivalent values at standard speed. The tests also show concretely the variation of strength due to variations of speed liable to occur during the test itself. The results plotted on cross-section paper give a remarkably even curve as an expression of the relation of strength to speed of application of load, and show much greater strength at the higher speeds.

It is common belief among polemen that the continual vibrations to which telephone poles are subjected, take the life out of the wood and render it brash and weak. Nothing is definitely known as to the truth or falsity of this idea. Tests will be undertaken to determine the effect of constant vibration on the strength of wood.

During 1905 the oilfields of the United States produced 134,717,580 barrels of petroleum, as against 117,080,960 barrels in 1904. The production was greater by 17,000,000 than that of any previous year. It is significant, however, that the value of the 1905 products was $17,000,000 less than that of 1904. The largest quantity of oil produced by any State in the Union is to the credit of California, which produced 33,427,473 barrels of oil in 1905, or 24.81 per cent of the total output. Next comes Texas, with 28,136,189 barrels or 20.89 per cent of the total, and third Ohio, with 16,346,660 barrels, or 12.13 per cent of the whole.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

PRINTING-TELEGRAPH.—J. D. WHITE, 50 Clanricarde Gardens, London, England. The object of this invention is to provide a "compound selective relay" for use in connection with an apparatus like that described in the specification of Mr. White in his former United States patent, so that the various local circuits which control the mechanism may be operated by a main circuit in such a way that messages transmitted along that circuit from an ordinary Morse or similar transmitter may be printed automatically in the proper characters at the receiving end.

Of Interest to Farmers.

GROOVING AND DITCHING PLOW.—W. M. BENSON, Newport, Pa. The purpose of the inventor is to provide a tandem gang grooving-plow, particularly adapted for use in semi-arid land, and to so construct the implement that the plows are set tandem or one directly behind the other, each consecutive plow-point being set deeper in the furrow than the preceding one for the purpose of producing a deep groove at one operation, and wherein also the plow-points are of graduated width, the lowest one being narrowest, the uppermost the widest.

FENCE-POST.—M. C. WIX, Milburn, Ky. Definitely stated, the invention has to do with the strand or fence wire fastening means, the object being to provide means of the character stated which shall not only facilitate securing of the strand-wires to the posts, but provide inexpensive and ready means for effecting the securing of the strand-wires to the posts.

PLOW OR CULTIVATOR.—W. T. GEORGE, Fayetteville, Tenn. The object of the improvement is to enable the distance between the shovels of the plow to be adjusted in a transverse direction with respect to the direction of advance of the implement, and, further, to provide an arrangement which will enable the degree of advance of certain shovels with respect to the others to be adjusted.

WEEDING AND CULTIVATING DEVICE.—T. J. KING, New York, N. Y. In this case the invention pertains to improvements in devices for extracting weeds, plants, and the like from the ground, the object being to provide a device of this character by means of which weeds or the like may be readily drawn from the ground with but little manual labor.

FERTILIZER-DISTRIBUTER. — H. T. YOUNG, Florence, S. C. The center of revolution of the wheels being eccentric to that of the sleeves, the knives are projected upon one side of the cylinder and retracted upon the opposite. By adjusting the collars circumferentially of the shaft the commencement of point of projection of knives may be varied. Edges of the knives in passage beneath the hopper follow the outline of the bottom thereof and remove a thin layer of fertilizer, and continued revolution of cylinder drops fertilizer on the ground. After dropping it the knives begin to retract into the cylinder thus cleaning themselves from the fertilizer. A continuous layer is spread, of a width equal to the cylinder's width.

Of General Interest.

SHIP FOR CARRYING LIQUID CARGOES IN BULK.—C. E. BURNEY, Newport News, Va. The invention is an improvement in ships for carrying petroleum or other liquid cargoes in bulk. It is steady in a seaway, operating on the same principle technically known as "winging the weights," which consists in removing weights on board of a ship from the center line out to the sides, causing her to be steadier and roll more easily.

COMPOUND CONDIMENT-HOLDER.—L. B. PARKER, Sulphur, Ind. Ter. The inventor has for objects the production of a device in which the caps of the shakers or distributers adapted to contain salt and pepper and other condiments can be readily removed and replaced and the perforations therein remain in a free and open state by the action of means carried by a closure-lid operable to close that shaker not in use.

APPARATUS FOR SMOKING MEAT.—C. SCHMITT, New York, N. Y. One purpose of the invention is to provide for a perfect combustion of the gas, and, further, means for heating and for producing smoke entirely independent of the chamber in which the articles are placed for smoking and cooking, thus preventing them from absorbing the odors peculiar to gas when burning, and also preventing the deposit of carbon on the products, which occurs at times under ordinary conditions.

SPEED-INDICATOR.—W. C. PLANK, Las Flores, Mexico. The object of this invention is to overcome the difficulty of taking the speed of shafts by producing an indicator in which there will be no danger of the spindle communicating its movement to the indicator-dial until such time as desired by the user. This is done by making the spindle in two sections, which are adapted to be automatically connected by pressing the indicator forward.

ATTACHMENT FOR MOUTHPIECES OF TELEPHONE-TRANSMITTERS.—W. C. PLANK, Las Flores, Mexico. The mouthpiece of a transmitter through constant use becomes foul and unsanitary. The invention consists of numerous concentric removable linings of antiseptic paper so molded as to properly fit the mouthpiece and fastened therein and which is adapted to be readily removed sheet by sheet as the inner sheet becomes soiled or unsanitary.

Hardware.

NUT-LOCK.—W. S. MASON, La Salle, Ill. The device may be employed with nuts of square, hexagonal, or other shape. An object of the invention is to provide a lock which will securely hold the nut upon the bolt against accidental displacement or loss, and which may easily and quickly be placed in position or removed.

ECCENTRICAL CUTTING-BIT.—J. H. TOMBRAGEL and J. F. SCHUNDER, Covington, Ky. The invention relates to bits used in boring holes in wood or metal; and one object of the improvement is to provide novel details of construction for a bit of the character indicated which is easily adjusted, enabling the lateral adjustment of the bit to the axis of its shank, whereby the bit will bore a hole of any desired diameter and depth within its capacity.

Household Utilities.

IRONING-BOARD. — L. C. KRANS, East Greenwich, R. I. In the present patent the invention relates to ironing-boards, such as used in laundries for ironing clothes; and the object of the improvement is to produce an ironing-board which can be quickly set up in position, which will maintain itself rigidly in postion when erected, and which will normally be folded into small space when not in use.

Heating and Lighting.

WATER-HEATER.—J. A. FREY, Washington, D. C. This portable heater is adapted to be connected with a source of water-supply and is provided with an eduction-pipe by which water which has circulated through the apparatus and become heated may be drawn off. The heating is effected very rapidly and economically by a kerosene or other burner. There are improvements in the heater proper or interior part through which the water circulates, and in connecting parts, comprising the casing, the flame-deflector, and supports thereof.

Machines and Mechanical Devices.

CRYPTOGRAPHIC MACHINE.—H. BURG, Mollkirch, near Rosheim, Germany. The invention is applicable to all type-writing machines in which the type are carried by a circle, even when they are mounted on type-bars or movable levers, and, indeed, all that need be done is to render movable the type-carrying circle and to connect the same with a mechanism of a kind to produce a predetermined series of various motions of said circle or a cylinder in order to obtain the discrepancy between the types marked on the keys struck and the types printed.

FILTER FOR DEFECATION.—R. M. VILLARINO, Campechuela, Cuba. A tank is employed for containing molasses or other syrup to be defecated and within which are disposed stirrers for the molasses in connection with shafts, means being employed for revolving the same in opposite directions. Means regulate the speed of each of the shafts, and further means clean the structure, and still further means are associated with the tank for receiving the overflow and which may be caused to return to the tank at will, said named means embodying a valve-controlled discharge-pipe for lees or sediment collecting therein.

Prime Movers and Their Accessories.

MUFFLER AND WHISTLE DEVICE.—M. ZWICKL, New Durham, N. J. This device is especially useful for small water-craft propelled by explosion-engines. Such water-craft must use a whistle for signaling purposes, and these are commonly blown by compressed air. The use of this air has a serious disadvantage, in that there is no visible signal when the whistle is blown, so that navigators of other craft have difficulty in locating the signal. The object is to produce a device adapted to be used in connection with an explosion-engine which will enable the steam-whistle to be operated when desired.

STOP MECHANISM FOR STEAM-ENGINES.—A. A. FULLER and D. K. CARTTER, Jasper, Ala. The invention is in the nature of a stop device for at will throwing a Corliss steam-engine or other engine out of gear from any part of a plant or by the automatic action of its governor when racing or running wild. It consists of the novel construction and arrangement of electromagnetic tripping devices and their connection with the valve-gear.

Railways and Their Accessories.

MINE-CAR.—C. A. KELLER, Rosedale, Ind. The object in this improvement is to produce a car adapted to be used for transporting the material mined and constructed so as to facilitate automatic dumping of the material carried; at the same time the car is made so as to enable the same to be readily adapted for carrying dirt or similar material which is to be shoveled from the car.

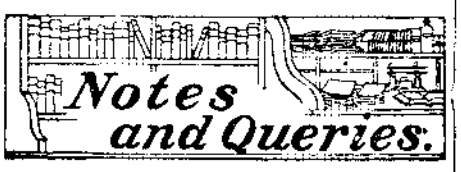
CAR-STAKE.—R. L. EDWARDS, Perry, Oklahoma Ter. The invention refers to car-stakes such as used at the sides of freight-cars employed for carrying lumber or logs. The object is to produce a stake having a mounting which will permit it to be readily adjusted into an erect position, but which will enable it to be quickly folded down in an inoperative position.

AIR-BRAKE SYSTEM.—W. H. EICHELBERGER, Royalton, Pa. The improvement provides a reliable safety attachment for the weakest point of an air-braking system—that is, the coupling between the sections—and that the attachment is operative under any abnormal condition which may be present. To prevent dragging of chains when the cars are uncoupled, they may be attached by any suitable means to the free end of the hose.

Designs.

DESIGN FOR A COVER-DISH.—R. L. JOHNSON, Stoke-upon-Trent, Staffordshire, England. In this ornamental design the cover-dish is of oval form. From the cover handle down to the edge of the cover the slope is gradual, varied, and pleasing. There is a gracefully scrolled handle at each end of the body of the dish. The body lines show a beautiful curve from the top to the base.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(10383) B. W. N. asks for information concerning transfer ornamenting. A. There are many different ways of putting on the ornament, some preferring one way, others a different method, according to circumstances and individual skill. We shall endeavor to give the most simple and successful method known. First, let it be understood that all pictures that show the colors complete are only suitable for white or very light colored brown; those that are covered with a white grounding, gold, metal, or silver leaf, can be used on any color, light or dark. After getting the work ready for ornamenting, give the picture a smooth, thin coat of some quick-drying copal varnish, thinned with turpentine (other preparations are used of which we will speak hereafter), being careful not to go beyond the outline of the design. Allow it to dry until it has a good tack, and put it on the work in its proper place. Roll it smooth with an India-rubber roller, or smooth it with a paper folder, until every part adheres well. (For very large pieces, it is well to lay them, after they have the right tack, between two sheets of damp blotting paper. It will stretch the paper and make a smooth transfer.) Now wet the paper, smoothing it down at the same time, until it has absorbed all the water possible; leave it about a minute, and pull off the paper carefully. Should any parts of the design still adhere to the paper, press it down again, wet-rub it until it separates easily. After having removed the paper, press the design on well and wash and dry it off. Should any blisters appear, prick them with a pin and press down. In a few hours the design may be varnished, which will increase the brilliancy of the colors. An improved method has been introduced which saves time and works with more certainty. The design is coated with a transfer cement of his own manufacture, without regard to outline, transferred as usual, and the traces of the cement around the design washed off, with the detergent (also his own invention), which will remove every particle of cement without injuring the colors or gold in the least. A few drops poured on a sponge or chamois skin are sufficient. For fine ornaments, having many fine lines and touches, it is necessary to use these preparations to make a neat job.

(10384) G. E. D. asks how to wind a small 75-watt dynamo to run same as a motor on a 110-volt direct current. How to reduce a voltage of 110 direct current to one of 20 volts most advantageously and in the simplest manner in order to run a motor wound for only 20 volts in circuit with a 110-volt current. A. Seventy-five watts are a tenth of a horse-power. We do not know where the winding for so small a dynamo can be found. The nearest we can come is a machine with a sixth horse-power. This is in Poole's "Designs of Small Dynamos," price $2. We cannot give you directions for reducing a 110-volt current to 20 volts, without knowing the amperes also which flow. You can do the calculating as well as we. Divide 90, the rest of the voltage, by the number of amperes. The quotient will be the ohms of wire to be used. A small iron wire will be a proper one for the resistance.

(10385) G. G. asks: 1. Is there a paper on the market which, when damaged, will be discolored by the passage through it of a mild electric current, such, for instance, as would be generated by five dry cells? A. Perhaps a paper for determining the pole of a circuit can be purchased. If not, it may be made as follows: Dissolve one part of phenolphthalein in ten parts of alcohol, and add 100 parts of distilled water. Soak blotting paper in this and dry it. Then soak again in a 20 per cent solution of sodium sulphate in water and dry again. To use this moisten a piece of the paper in water and apply the wires to it. The space around the negative pole turns a bright red. 2. Is there any harmless chemical preparation which would cause paper dampened in it to take a dark color by the passage through it of such a current? A. Dissolve some potassium iodide in water, add starch and bring to a boil. Soak paper in this, and while damp apply the wires as before. A dark color is formed around the positive wire. By moistening the paper of No. 1 with the starch solution two colors would be formed.

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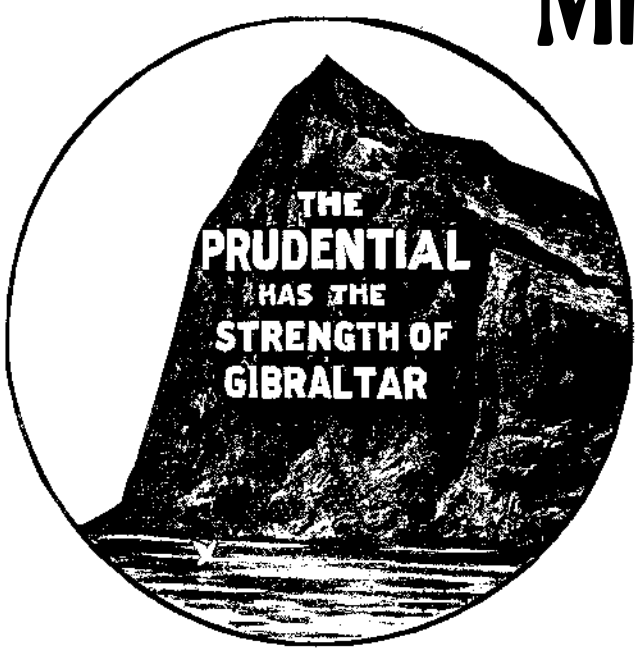

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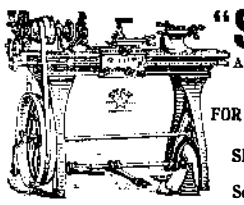

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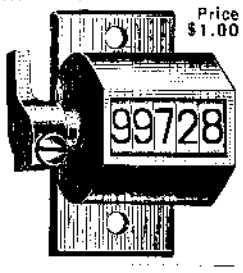

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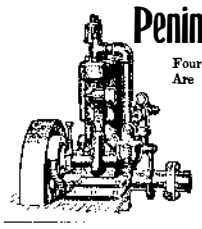

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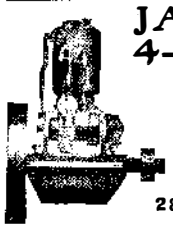

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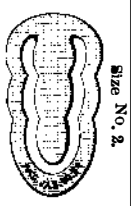

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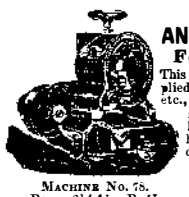

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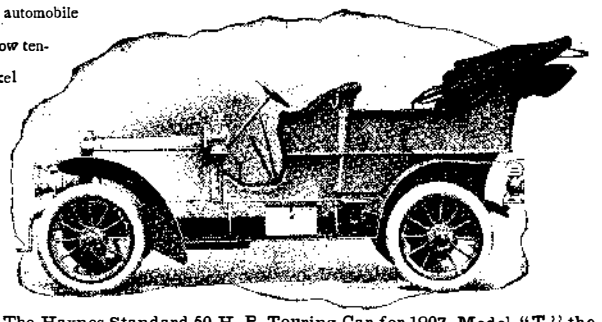

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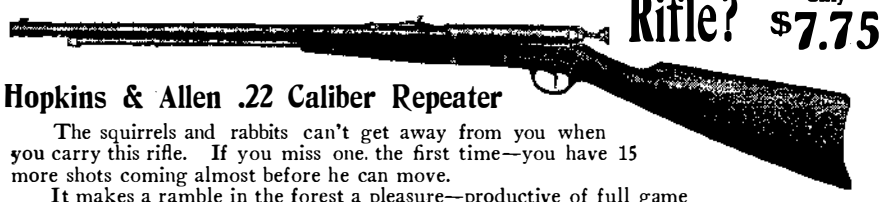

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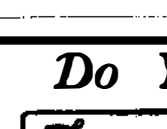

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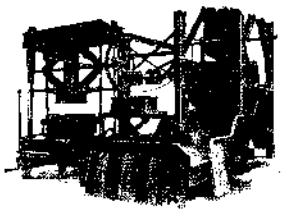

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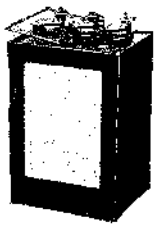

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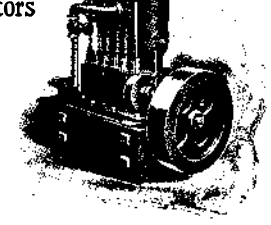

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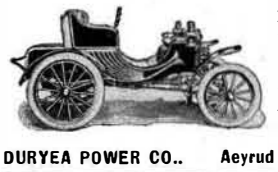

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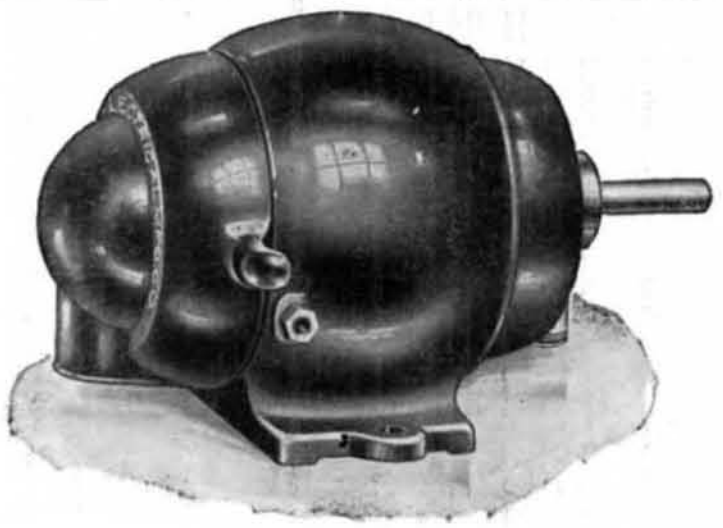

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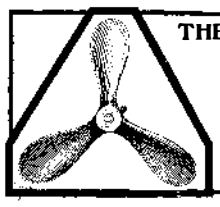

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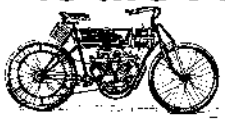

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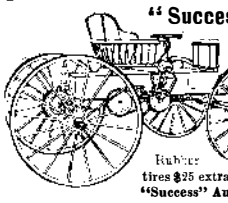

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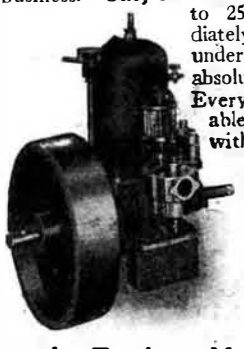

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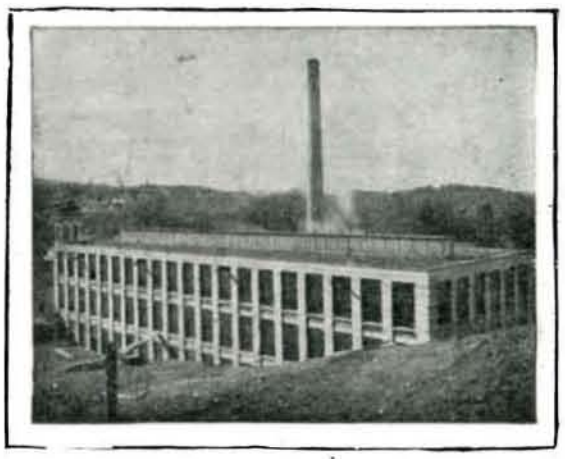

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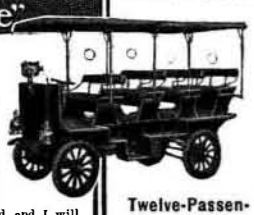

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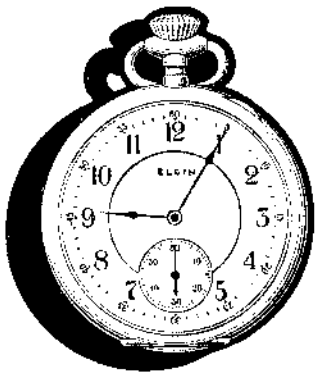

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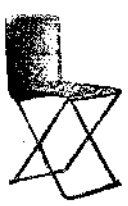

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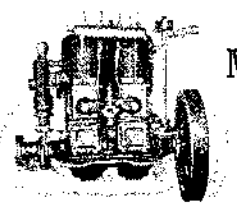

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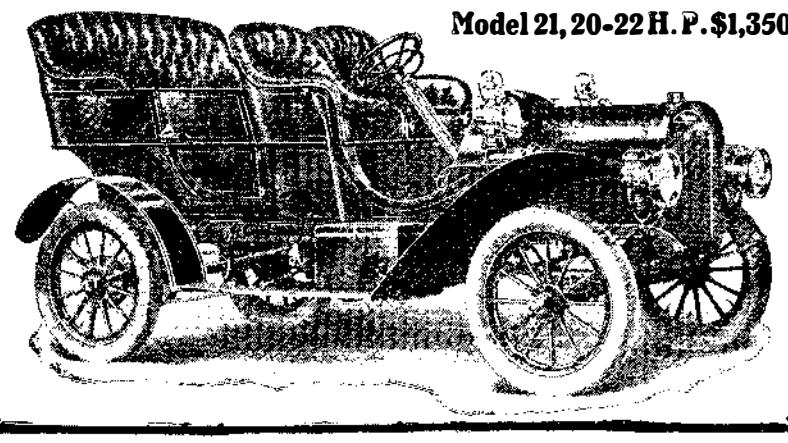

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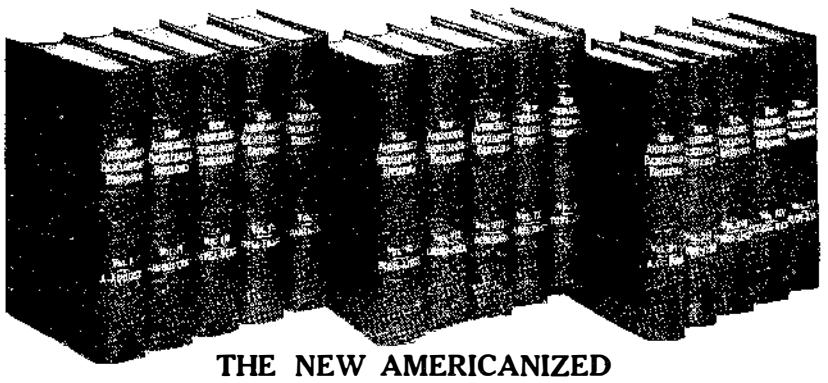

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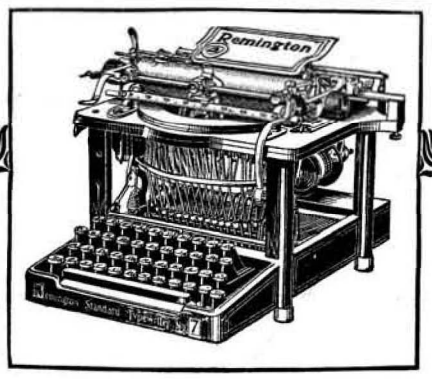

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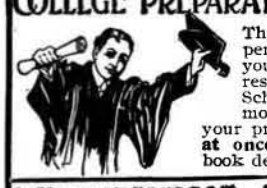

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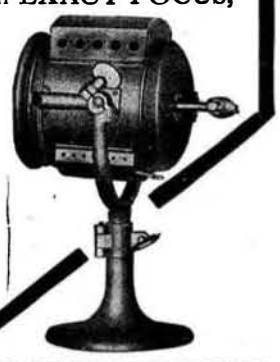

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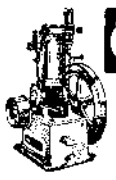

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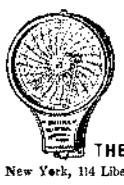

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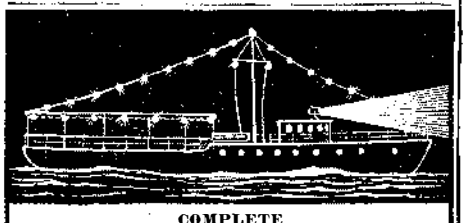

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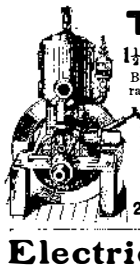

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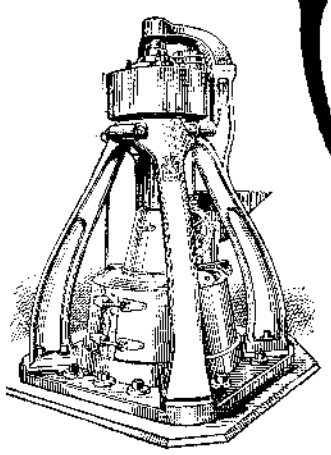

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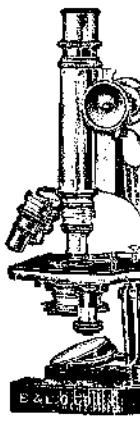

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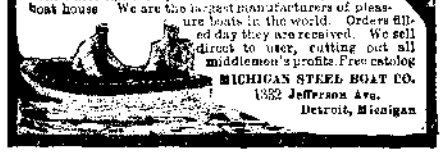

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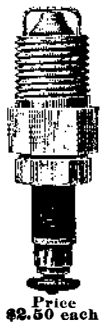

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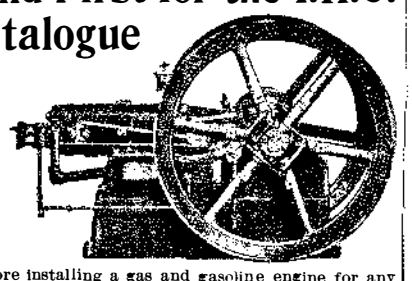

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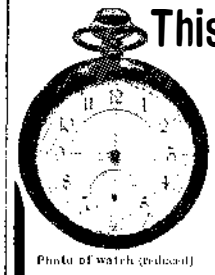

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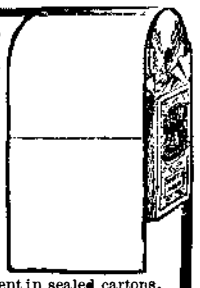

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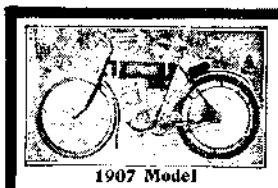

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